

Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

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The Last Issue

WITH this number the Engineering Record, after an honorable career of 40 years, terminates its separate existence. We witness its going not without some regrets, though naturally we rejoice, when all is said, at the brighter future which is opening before it, due to its consolidation with *Engineering News*.

For 40 years it has been growing up with engineers and contractors, cherishing their aspirations, sympathizing with their difficulties, fighting their battles with them. Strong men, notably Major Henry C. Meyer, its founder; James H. McGraw, its present publisher, and John M. Goodell, editor during the period of its greatest development, have written their personalities into it. Major Meyer laid its foundations broadly—in truth, in courage, in high ideals. For 25 years he conducted it and won for it an enviable reputation for accuracy, sanity, breadth of view, and courage. Fortunately it was that when he wished to retire from active life there was available a publisher with the same high ideals, and with great ability, foresight and courage, to take up the work where he laid it down.

The present generation of readers knows what Mr. McGraw and Mr. Goodell did with the paper. Standing firm on the policies Major Meyer had established, they expanded it in size and scope in order that it might serve better the engineer and the contractor. That this service was appreciated is shown by the growth of the circulation in 15 years from 4000 to 20,000 copies.

Simultaneously with the consolidation of the Engineering Record with *Engineering News* the undersigned lays down his editorial pen. He may be permitted, therefore, to have a personal word with the readers in the issue which terminates both his régime and the separate existence of the paper. For four and a half years he has had the good fortune of occupying the editorial chair. Much honor has come with it and all too much credit for his humble part in the development of the paper in these later years.

Never has any journal been more truly the product of an organization than has been the Engineering Record. It shows clearly the impress of each and every man who is on the staff to-day. To Mr. Tomlin, as managing editor, especial credit is due. He has conducted the paper ably during the frequent absences of the editor. Moreover, his impress is shown in the human way of presenting articles, and in the use of graphic headlines and introductory paragraphs which

have helped to secure so wide a reading for the paper. Mr. Stark deserves all the credit for the excellence of the railroad material, and particularly for the sane and extremely vigorous attitude on valuation matters. Mr. Hammond has brought out the contractor's point of view, and through articles, editorials and the invaluable "Hints for the Contractor" has made the paper of exceptional value to those who execute the designs that the engineer prepares. Mr. Williams, during his brief two years on the staff, put a new spirit into the structural articles and enabled the paper to present probably a more noteworthy collection of articles on steel and concrete subjects than have hitherto been presented in the same length of time in any other paper. Mr. DeBerard and Mr. Bowers, as Western and Pacific Coast editors respectively, have cared with striking success for the engineering interests of the Middle West and the Coast.

But even this recital does not tell the story adequately. It does not tell the spirit with which each man worked. It was teamplay of the finest kind. Each man carried fully the responsibility of his own position, yet found time to boost the other fellow and to encourage him in his work, especially in the new ideas that each was constantly developing. It is that spirit which drove the paper ahead and that brought forth the frequent question a few years ago, "What has happened to the Engineering Record? It is developing by leaps and bounds."

And still the story is not completely told. What the editors did required money—much money—and that could not have been forthcoming were it not for the faith which Mr. McGraw and the business department of the paper reposed in the future of the field and in the plans that were being followed. Without their firm backing results would have been impossible. Then, too, no small credit is due those, particularly Mr. DeWolfe and Mr. Holland, whose typographical and artistic genius is responsible for the handsome covers and the pleasing and vigorous typographical appearance for which the paper has been distinguished.

One last factor—and a most important one—needs attention and then we shall close.

The editors can never adequately express their appreciation of the help and encouragement they have received from their friends outside the staff—engineers and contractors from Coast to Coast, from Canada to Mexico. They have given freely of material. They have com-

mended things well done. They have kindly criticised when they felt that our policies were wrong. Without their help and advice the progress would have been slower, the results less certain.

We trust that their good will and their disposition to help will be transferred undiminished to *Engineering News-Record*. We predict with confidence that the combined journal will do its utmost to deserve the continued and hearty support of engineers and contractors.

The writer's greatest regret in leaving editorial work is that he will lose the close contact with these friends of the *Engineering Record*—the engineers and contractors whom he can truly call his friends and who have been of such material help to him in the development of the paper. As an executive officer of the company which will own *Engineering News-Record* he expects to follow its development closely, to sit in at the editorial councils, and to have some influence in molding its editorial policy.

While his direct contact with the field, therefore, will be less than it has been in the past, he does not expect to be divorced from it entirely. Rather, his interest will be heightened, for he will have opportunity because of his semi-detachment and his supervision of papers in all of the five major engineering fields—civil, mechanical, electrical, mining and chemical engineering—to see the larger relationships of engineering and to aid *Engineering News-Record* in interpreting them to the field.

Au revoir, therefore, is the correct expression rather than farewell.

E. J. Mehren

A Flareback

THIS journal has taken occasion in the past to criticise the cowardly attacks made, in unsigned circulars, on certain engineering materials, particularly for paving work. Possibly we should let the matter drop, for the average decent citizen has nothing but contempt for a sneak, and he is a sneak who sends out the literature to which we refer. Recently there was sent us by the city engineer of a Southern city a copy of an anonymous circular criticising a concrete street pavement. The engineer in his letter of transmittal said, "Concrete must be all right to bring this out and nobody willing to admit its authorship." In other words, just the opposite of the desired effect was produced. There was a flareback.

Undergraduate Preparedness

IN ORDER to be able to place before the students of Massachusetts Institute of Technology a clear view of the service they might render the nation in case of war, the Institute Committee, composed of one repre-

sentative of each of the student activities, has placed before the undergraduates a report admirable in scope, clarity and brevity. The committee conferred not only with members of the faculty, but with army officers and prominent business men. As a result it recommends that if hostilities come undergraduates withhold their service completely and await developments, in order that they may be placed where they can do the most good. The report points out that because of the limited experience and technical training of undergraduates, the services which they can perform are not apt at the start to carry heavy responsibilities, but that, nevertheless, their qualifications are such that positions may develop where they could be of much more value than if they enlisted before the whole situation could be properly studied. In addition to this sage counsel the report gives an analysis of the services which undergraduates might render in the army, in the navy and in the industries upon which the fighting arms depend. The step taken by the Institute Committee is an excellent one and deserves to be followed immediately by student or faculty bodies in all of our engineering colleges.

"Unless Your Justice Abound —"

THIS JOURNAL has repeatedly called attention to the need of a radical change in attitude on the part of employers if the relations with employees are to be put on a satisfactory basis. Gradually the doctrine of employing labor just as cheaply as one can get it, of making concessions in the way of working conditions only when they are wrung from those in authority, has given way to the standard of justice. We doubt, however, whether even this standard, if it is held coldly, will produce the desired results. Justice there must be, but justice tempered with a real interest in the welfare of the worker. "Unless your justice abound more than that of the Scribes and the Pharisees" expresses the idea, for we believe that the justice applied in industry, with few exceptions, has been the cold, grudging justice that the Master condemned. How that new justice—justice made truly even by interest in the worker—expresses itself in the conduct of some American organizations is probably better set forth in a book entitled "New Ideals in Business," by Ida M. Tarbell, than anywhere else in recent business literature. It tells how industries and workers have been benefited by the construction of new workshops, by the introduction of safety devices, by caring for the health of the working force, by better housing, by shorter hours, by incentives of various sorts—all leading to a stabilizing of industrial conditions. It is impossible here to go into details. The book can, however, be unhesitatingly recommended to those who are confronted with labor problems in any sort of organization. If they do not gather inspiration that will lead to improved relations with the workers, they are sadly lacking in that enthusiasm and vision which are prime essentials for leadership.

Culverts Free; Hauling Extra

IT IS IMPROBABLE that the duties of editing will ever pall on us as long as the present Board of County Commissioners of Laramie County, Wyoming, remains in office. There is a freshness in its method of attacking the question of highway specifications which makes the laborious documents ordinarily thought necessary seem strained and unnatural.

Surely the opening paragraph of the document before us is naïve and comprehensive: "County to furnish grader and road finisher, which must be returned to Cheyenne at contractor's expense before payment will be made for work accepted." Then, relying upon the intelligence of the contractor, the second paragraph starts off: "They shall be 32 ft. wide, with gradual incline to the center of 18 in." Need anyone inquire as to what is to incline to the center of 18 in.? No! The chairman of the board is evidently dealing with men possessing remarkable intuition. But where detail is demanded, he becomes precise to a startling degree. For instance, "All rock must be thrown completely off the road." Then, to allow for a play of the individual ingenuity of the contractor, he continues: "All places where fills are especially required shall be made by teams either hired by the day, or the fill will be let by the yard."

The unusual economic conditions and the state of the labor market in Laramie County are illuminatingly presented in the following: "Culverts shall be put in by the contractor without extra charge except for hauling same to place where they are required." Nor would the chairman of the board in any way question the engineering skill and good common sense of the contractor by even insinuating that his interest in the common weal and understanding of road engineering is lacking. So, in mentioning the rather unimportant item of drainage, the specification is intelligently vague, reading as follows: "Ditches must be so made that they drain to the best advantage."

But do not think that the interests of the county are in any way neglected. This is provided for in a most complete manner, and with an economy of words which is as significant as it is startling. No long detailed description, no baffling "except that," no hurried reference to standards. No! The county simply built a specimen mile and the "specimen mile completed will be shown to bidders and all work must average up to, or be better than, specimen shown."

And to think that this gem of engineering description was born through a desire to save the county the per diem of the ordained county surveyor!

The Engineer as a Leader

THE POINT at issue is the present war and the undeniable supremacy of the engineer in the handling of its problems.

H. G. Wells, whose place as a thinker ranks only below his position as a novelist, has made this so clear in a recent book, "Italy, France and Britain at War," that to deny the conclusion would be futile. The professional soldier of the English army seems actually to be a hindrance, always blocking any advance in tactics or mechanical aids with his bland, "It isn't done, you know." Wells is particularly severe in the treatment of the officers of his own army, finding those of France and Italy far more eager to avail themselves of engineering stratagem. It is in fact to the technically trained mind that every new situation is put for solution, and each success of defense or offense is measured in terms, not of men and guns, but rather of transportation and construction. It is all too apparent, furthermore, that war has proved the military attitude toward troops, the harsh voice and senseless class distinction, must necessarily give way to an attitude of consideration which is strangely like that advanced by efficiency engineers as the highest form of discipline.

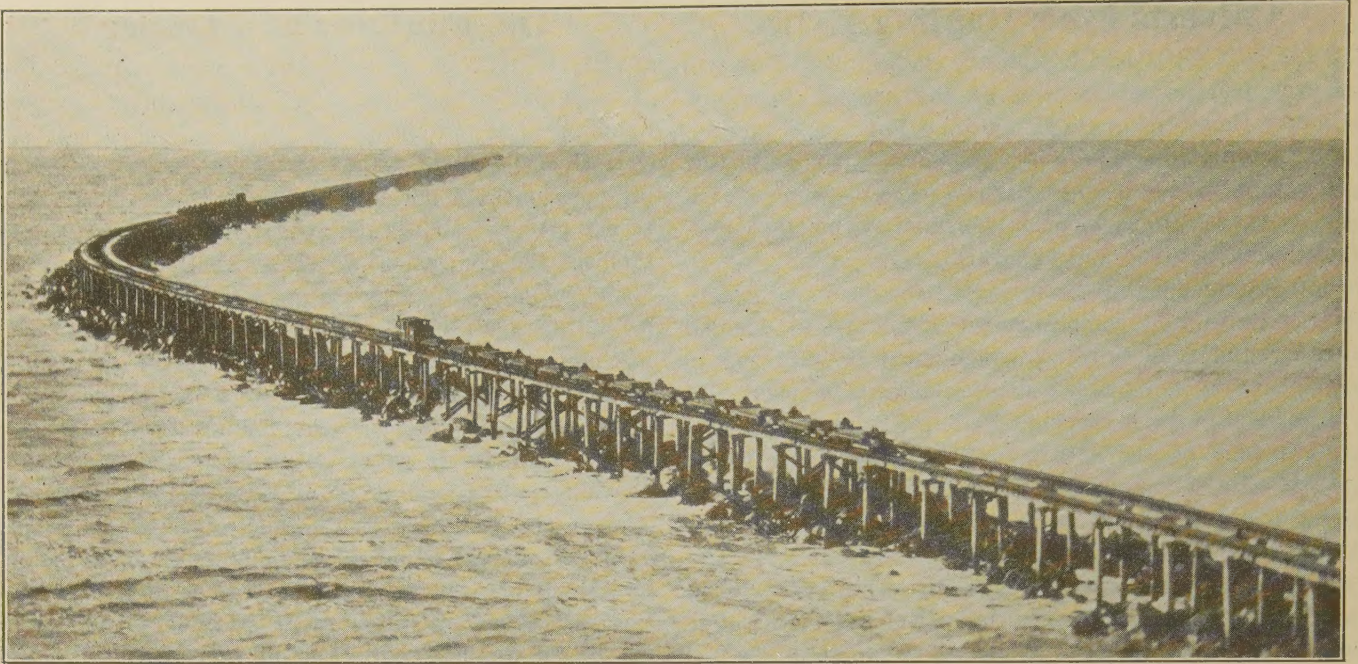
In its essence, modern war is simply an intensification of peace. Its problems are those of industry, more highly accented, condensed surely, but giving to the elements of time and space a consideration that makes much of the study of manufacturing problems seem childlike. Nor in the work of the engineer engaged in war is economy of material and accuracy of workmanship neglected; on the contrary, these last receive an attention which is remarkable in a process whose end is destruction rather than construction. The European conflict has shown that in all this detail, upon which successful warfare of to-day depends, the technical man, though trained in the art of peace, has not only proved his superiority in the handling of the secondary category of materials, but also has won universal acknowledgment on account of his understanding of purely human problems.

There is a point at which modesty ceases to be a virtue and becomes humbug. When a definitive crisis has arisen, and has been met not only adequately but with brilliance, not to acknowledge one's capability is an avoidance of responsibility amounting to laziness or even criminality. When peace finally comes, engineers, to quote from the presidential address of Henry C. Adams before the Society of Engineers, must show that they "are leaders and not merely workers—hewers of wood and drawers of water."

Notice to Subscribers

This is the last issue of the Engineering Record. Subscriptions for it will be continued automatically as subscriptions for Engineering News-Record. Those who have

subscribed for both Engineering News and Engineering Record will receive the combined paper for a time equal to the sum of the unexpired portions of both subscriptions.



Columbia River Jetty Rapidly Nearing Completion

North Enrockment Will Complete Control Work, Eliminating Huge Shifting Bar at a Total Cost of Over \$14,000,000

By W. P. HARDESTY
Portland, Oregon

THE COLUMBIA, the second largest river in the United States, is navigable for ocean craft for more than 100 miles, and provides access to Portland, Ore.; but entry to it is made difficult by an immense shifting bar. A jetty to the south of the mouth was started in 1885 and completed in 1913; but although supplemented by direct dredging, the channel across the bar has proved inadequate on account of the increasing draft of vessels. In 1905 Congress provided that if the south jetty did not establish an adequate channel with a depth of 40 ft. at low water, this jetty should be extended and a new one built on the north, or Washington side, of the river, to run directly seaward from Cape Disappointment, a projecting headland which fronts westward on the ocean and eastward on Baker's Bay.

Under this authorization, preliminary work on the north jetty began in May, 1912, and is now about 75 per cent completed. For nearly its entire length of $2\frac{1}{2}$ miles the work runs about S. 50 deg. W., but turns nearly west when reaching a point just 2 miles from the south jetty, and then runs parallel to the latter, terminating just 2 miles north of the south jetty. The work should finally be brought to a finish some time during the present year at a cost of between \$4,500,000 and \$5,000,000, which, added to the cost of the south jetty, \$9,594,150, will make the total cost of the work about \$14,500,000.

Immediately to the north of the rocky promontory of Cape Disappointment is a saddle in the ridge not more than 20 or 25 ft. above low tide, separating Baker's Bay

from the ocean. Through this divide runs the tramway from the receiving docks in the bay to the jetty trestle in the open sea. Fort Canby, with rather ancient fortifications, has its landing on Baker's Bay, and to this point a plant used in the construction of the south jetty was transferred from Fort Stevens.

Receiving wharves, quarters, shops and a complete layout of railroad tracks were constructed at this new location, and since the bay was quite shallow at low tide a channel 11 ft. deep was dredged to accommodate the stone-carrying barges. This channel necessitated the removal of 2,100,000 cu. yd. of material.

NEW JETTY TRESTLE DIFFERS FROM OLD DESIGN

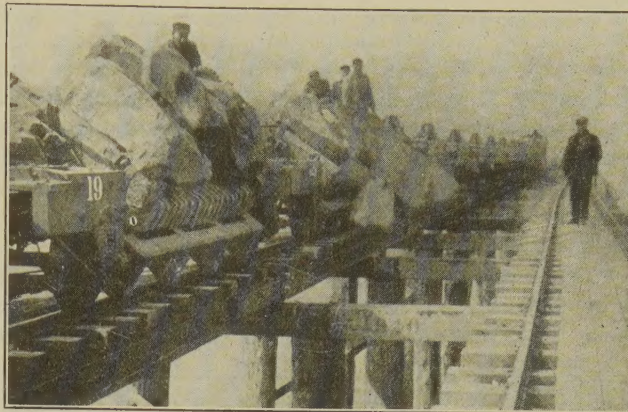
The experiment tried on the south jetty of using layers of burlap to protect piling against the teredo, having proved unsuccessful, was abandoned, and the principal reliance was placed on the use of green timber. No timber was cut dry, and any that might have dried for a few months after being cut was excluded from the work. It appears that the sap and pitch, being tenacious and sticky, does not form an attractive working medium for boring animals, experience indicating that green piles are usually exempt from an attack for about one year. After this period, the pitch has hardened and protection ceases. A further advantage in the use of green timber is that it is more elastic and better able for this reason to withstand the constant swaying caused by the heavy seas before the enrockment fully protects it from the waves.

Specifications called for a pile having a minimum top diameter of 13 in. and a maximum butt diameter of 26 in., some piles used running in length up to 120 ft. The trestle spans are 18 ft., each bent consisting of two pairs of piles, one for each track, which are framed together with eight 3x12-in. by 28-ft. pieces, two sets of two each being used on each side. This size of bracing was used in preference to 6x12 in. on account of the greater ease in handling. No longitudinal bracing was employed. The bracing was drift-bolted to the piles. The design is radically different from that used on the south jetty, extending about 20 ft. below the cap, while that on the south jetty reached only 7 or 8 ft., though the other details of the two trestle designs are similar. The tramway tracks are 3 ft. gage, spaced 13 ft. on centers.

ENROCKMENT KEPT CLOSE TO PILE DRIVING

The body proper of the jetty was formed by dumping rock from the trestles. This rock is of three sizes—Class A, from 6 to 15 tons; Class B, 1000 lb. to 6 tons; Class C, 20 lb. to 1000 lb. A certain amount of Class C rock was dumped as quickly as possible after the completion of the trestle work to riprap the bottom against scour. Experience on the south jetty made it apparent that it was a waste of time and money to build the trestle far in advance of enrockment, as the heavy storms repeatedly swept this trestle away. Due to this precaution, only six or seven bents were lost during the earlier work on the north jetty, and only one during 1915.

The teamwork of the men was so perfected that during one 8-hour shift 6 bents, or 108 ft., were built, including placing of caps, bracing, and placing of stringers. This is said to be double any other record made



VERY LITTLE ACTUAL HARM RESULTED FROM DUMPING ROCK

along the Pacific Coast for this class of work. Each pile was driven until the head was at the proper level, no cutoff being necessary.

TIDE SCAURED BOTTOM TO UNIFORM DEPTH

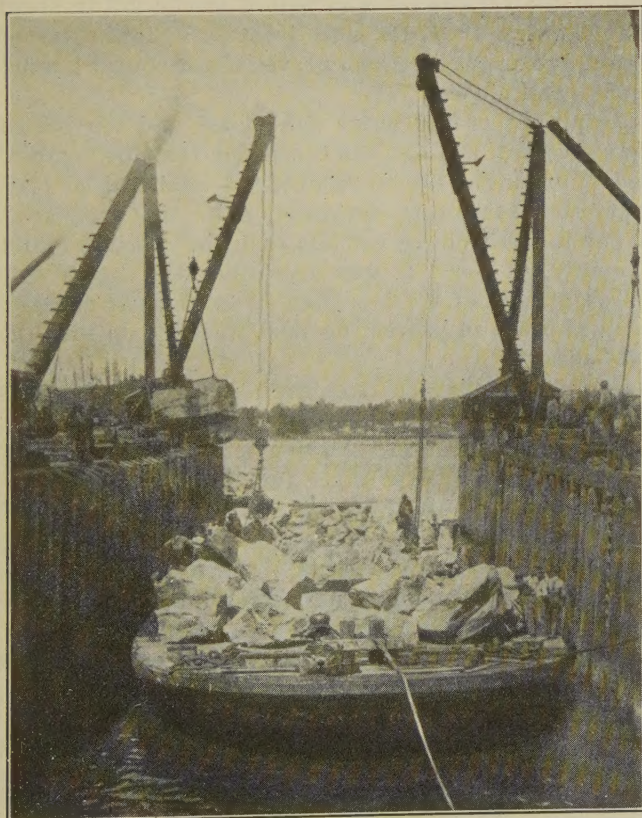
No estimate can be made from an advance profile of the bottom as to what the amount of stone on any part of the enrockment will be. Invariably as the trestle and enrockment were extended, the bottom just beyond the end scoured out rapidly, due to the sweep of the tide. Though the depth scoured depended somewhat on the length of time that the end of the trestle was left unprotected, a remarkable feature is that the amount of rock per linear foot differs only little throughout the work. For example, the enrockment at a location having a normal depth before scouring of 9 ft. was only about 15 per cent less than one with a 38-ft. depth.

Obviously, no uniform cross-section of enrockment under the conditions here existing is possible. The intention is to bring the top to about mid-tide after a full settlement and to widen the top to the full width of the trestles, or about 22 ft. Cross-sections of the completed enrockment show side slopes as steep as $\frac{1}{4}$:1, followed within 50 ft. by those of $1\frac{1}{2}$:1, averaging perhaps about $1\frac{1}{4}$:1. The $\frac{1}{4}$:1 slope is found far under the water.

125,000 TONS OF ROCK PER MONTH

The stone in broken bulk runs about 120 lb. per cubic foot, the weight, solid, being about 175 lb. per cubic foot, and is a sort of metamorphosed sandstone found only at a great depth in the quarries on the Columbia River. When the estimated amount of 3,000,000 tons has been placed, the rock will average about 250 tons per linear foot, or 4500 tons per bent. A record of the carloads dumped in each bent is kept, and by this means the total is known at least approximately. Considerable expertness has been obtained in dumping rock, and while cross-braces are often broken, no particular harm is done if the enrockment is well up.

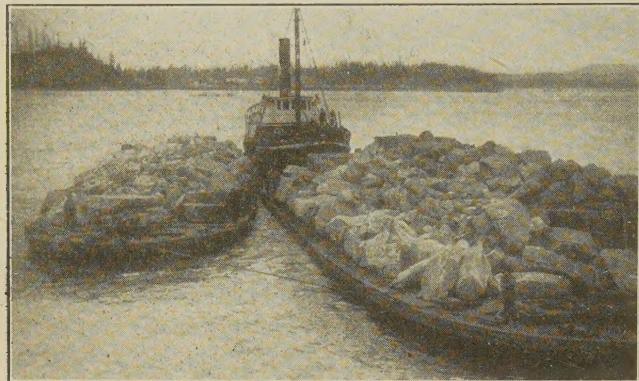
The stone is brought on fleets of three or four barges of about 900 to 1000 tons each to the special docks and tracks built at Fort Canby. Here the equipment consists of a dock with 10 tracks, 10 derricks, a steam plant for supplying the hoisting engines, twelve 17-ton locomotives and all necessary dump cars. In loading Classes B and C rock the car bodies are lifted from the trucks by derricks with a four-way chain attachment and are placed on the barges. Class A rock is handled



CLASS A ROCK IS SWUNG FROM BARGE TO CAR

directly from barge to mounted car body by derrick. Four barges can be unloaded at one time, two derricks being at work on each barge. All car handling is done by gravity, the locomotives picking up the completed trains and drawing them to the track scales, where the cars are weighted by twos. When working to full capacity, eight or nine train crews are employed, each with 10 cars, which handle about 90 train loads per day, totaling 125,000 tons of rock per month.

The enrockment begins 464 ft. out from high-tide shore line, or about one-half mile from the loading dock. The trestle is 12,303 ft. long and the enrockment

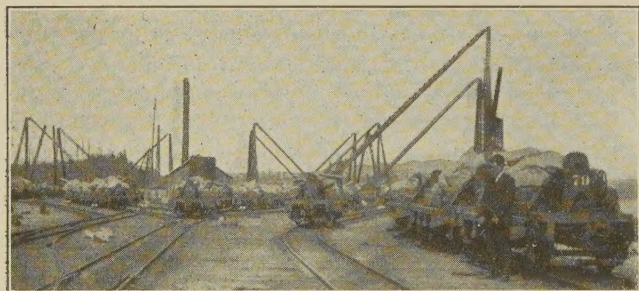


1000-TON BARGES TRANSPORT ROCK FROM QUARRIES ON THE COLUMBIA RIVER

11,839 ft. The three bends in the trestle are made with 6-deg. curves.

For safety in operation the main part of the trestle is divided into six blocks of about 1800 ft. each. During foggy weather an operator is stationed at each of the booths which separate the blocks and actuates semaphore boards about one train length away from the booth. Though there is telephone connection between booths, ordinarily the trains are so well spaced that no semaphore operation is necessary. However, as each train passes a booth the operator telephones ahead to the next booth, giving the number of the train, so that a complete tab is kept on the location of all trains.

Contract was entered into with the Columbia Con-



ALL ROCK TRAINS ARE MADE UP BY GRAVITY

tract Company of Portland to furnish and deliver stone for the enrockment at an average price of \$1.10 per ton of 2000 lb. Necessary supplies of lumber, fuel, etc., were purchased in the same manner.

Work began on the installation of the plant in May, 1912; on the trestle, during the fall of 1913; and the placing of rock began in February, 1914, though the plant was not fully completed until the summer of 1914. The total cost of placing 3,000,000 tons in en-

rockment, including the proper pro rata for all factors of expense, will probably be between \$1.50 and \$1.60 per ton. This depends somewhat on the appropriation available, as work done with a full force and without interruptions during the favorable season is much more economical.

All operations on jetty construction have been conducted by day labor under the direction of the Corps of Engineers, U. S. A. The jetties are included in the second Portland (Oregon) district. The district officers in charge of the north jetty, for the most part, have been Lieut.-Col. C. H. McKinstry and Major Henry C. Jewett. The U. S. assistant engineer in immediate charge of the work has been C. M. Cram, to whom the writer is indebted for data used in preparing this article.

Railway Engineers Compare Timber and Concrete Trestles

Committee Recommendations on This and Other Subjects Accepted at Eighteenth Annual A. R. E. A. Convention Summarized

THIRTEEN different committees of the American Railway Engineering Association were able last week to get recommendations adopted. These subjects, summarized below, will be printed in a supplement to the *Manual* until a new edition is authorized.

Roadway.—All the recommendations as printed in Bulletin 194 were adopted, including revisions of recommendations relating to steam-shovel work, blank forms, shrinkage or expansion of material in embankments, roadbed cross-sections, and conclusions as to grade separations.

Ballast.—It was concluded that the best quality of each of the various kinds of ballast should fall in about the following order of effectiveness: Stone, washed gravel, broken slag, pit-run gravel, chatts, burnt gumbo, or clay and cinders.

Definitions of the terms sub-ballast and top ballast were accepted, and also the conclusion that the depth of ballast under the tie, on roadbed material such as clay, loam, etc., subject to deformation by the application of live load, should be not less than the spacing, center to center, of ties. It was also concluded that a sub-ballast blanket of not less than 12 in. thick is effective in most cases in preventing mud working up into the top ballast.

Ties.—An additional specification for crossties was accepted to the effect that ties made from white oak, cypress and dense pine showing a greater amount of sapwood than is permissible for ties to be used untreated will be classed among ties to be treated; also one relating to the limitation of time after cutting and before delivery, the actual figure being left blank.

Track.—Specifications and designs for cut and screw spikes proposed were adopted, with a few minor changes, as were definitions of main line, branch line, spur and main track. A standard gage to test the screw spikes was adopted.

Buildings.—With minor changes, the convention accepted matter with reference to freight-house scales and ashpit designs proposed in Bulletin 194.

Wooden Bridges and Trestles.—Conclusions as to the

comparative merits of ballast deck and reinforced-concrete trestles were adopted as follows: Creosoted ballast-deck timber trestles present the greater fire hazard, are slightly less superior in their stability against the action of floods, give the same service, present no difference from appearance standpoint and are less in accord with the theory of conservation of natural resources.

The convention concluded as to the merits of galvanized-iron fastenings for timber trestles, as compared with plain iron and steel, especially in creosoted structures, that creosoted timber had a tendency to protect plain iron or steel when embedded; that the steel will last as long as the timber; that it is good practice to use steel drift bolts in straight creosote-treated timber; that galvanized fastenings exposed to brine drippings last longer, but that the information is not sufficient to state whether the added expense is justified, and that it is not necessary to use galvanized fastenings in creosoted structures over salt water.

The conclusion that creosoted timber trestles are more economical than concrete, except when the cost of the concrete structure is less than one and one-half times the cost of the wooden structure, was not accepted.

Masonry.—Specifications for constructing concrete piles, for surface finishes of concrete, formulas on retaining walls and the standard specifications of the joint committee were adopted.

Signals and Interlocking.—Additional specifications and standards adopted by the Railway Signal Association were accepted for printing in the *Manual*.

Rules and Organization.—The clearance diagram adopted in parts last year, as redrawn, and reconciled with that of the committee on electricity, was adopted for new construction work.

Water Service.—A few minor changes, intended to render clearer the language in the *Manual* relative to softeners and to remove certain ambiguities, were adopted.

Yards and Terminals.—Three hump profiles proposed for cold, moderate and warm climates were adopted; also the conclusion that the maximum grade over track scales shall not exceed 1 per cent, and shall preferably be less than 0.6 per cent.

Iron and Steel Structures.—A new formula for impact, $I = 30,000/(30,000 + L^2)$, where L is the total length of the span, was adopted to replace the present formula. It was concluded also that chilled cast-iron plates not less than 30 in. wide are the best form of protection to steelwork from locomotive blasts.

Wood Preservation.—Specifications for fractionation of creosote oil were adopted which conform to those of the American Wood Preservers' Association and those up for adoption in June by the American Society for Testing Materials. A standard apparatus for zone water sampling in creosote oil was accepted.

Wood Pipe Ages Less Than Iron or Steel

Based both on theoretical investigations and on field tests, the author of Bulletin 376 of the U. S. Department of Agriculture concludes that wood pipe will convey about 15 per cent more water than a ten-year-old cast-iron pipe or a new riveted pipe, and about 25 per cent more than a cast-iron pipe twenty years old or a riveted pipe ten years old.

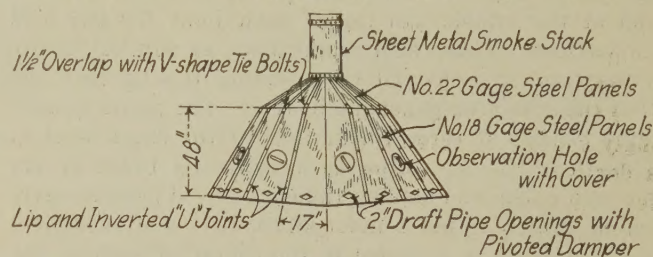
New Stump Burner for Logged-Off Lands Requires No Blower

Is Easily Handled, and with Minimum of Attention Will Dispose of a Large Stump in from 24 to 40 Hours

By LE ROY W. ALLISON
Newark, N. J.

AN INTERESTING and effective stump burner has recently been perfected to provide a thorough and practical means of reclaiming fertile lands covered with tree stumps, such as are found in great abundance in the western sections of the country. It is easily put together or moved, and requires little attention while in operation.

Various types of stump burners have been devised for clearing agricultural tracts encumbered with tree butts and underbrush, generally known as "logged-off" lands, as well as for other purposes for the direct utilization of the stumps. The Ross stump burner, described in the *Engineering Record* of July 25, 1914, page 95, manufactured at Portland, Ore., consists of a closed sheet-iron hood to be used in connection with a blower for



THIS STUMP BURNER IS EASILY PUT TOGETHER OR MOVED

draft creation within the hood for stump consumption. This burner has proved very efficient in service, particularly as regards rapidity of operation, stumps being consumed in from 2 to 4 hours, depending on the size and character. Another interesting use for stump-hood equipment has been found in the pine timber lands of Mississippi, where at Laurel such is employed to particular advantage in extracting heavy pine oils during the work of converting the stump into a fine grade of charcoal (see the *Engineering Record* of June 10, 1916, page 764.)

In contrast with the closed type of hood burner, this latest stump burner consists of a metal housing with various apertures for particular service, with smoke-pipe connection at the top. It is constructed in sections to provide for any class of service, covering both large and small stumps. By the use of movable draft pipes arranged around and near the base of the burner, it eliminates the necessity for any blower or other artificial draft device, the required draft being brought about by natural conditions and hood construction, and in a highly efficient manner for the service designed. While this burner operates more slowly through the use of natural draft, demanding greater periods of time for stump consumption, the operating cost is reduced to a minimum, the primary expense being that of labor and attendance, which is low when a number of burners are in operation on the same land at the same time.

This burner, known as the Hubbard stump burner and produced at Seattle, consists of an adjustable steel

hood of two principal sections to form a base and top, designed to be placed over the stump, or stumps, in operation. Each section is built up to any desired size by means of interchangeable panels, allowing the utmost facility in handling and erecting on the site. The lower section panels, when joined together, have a clear width of 17 in. at the base. Installed in position, using such number of panels as is required, they form a frustrum, with the upper edge to serve as the support for the top section. This top section also forms a flatter frustrum, terminating with an opening 12 in. or less in diameter, depending on the number of panels used, and is equipped with a smokestack, as shown. Each panel is arranged for connection to the adjoining panel in the field with stove bolts or strong cotter pins.

LOWER PANELS

The lower section panels are made from steel sheets of No. 18 gage. Each panel is of trapezoidal shape, 11 in. wide at the top, 19 in. at the base, and about 48 in. high. On one edge of each panel a $\frac{1}{2}$ -in. lip is bent at an angle slightly in excess of 90 deg., while the other edge is made in the form of an inverted U, $\frac{1}{4}$ in. wide and $\frac{1}{2}$ in. deep. Bolt holes are punched near the bottom and at the middle and top of each joint for the field connections. These field connections, as will be readily understood, are effected by inserting the lip into the U of the adjoining panel and bolting. The joints accordingly consist of three thicknesses of the sheet steel to a depth of $\frac{1}{2}$ in., acting as a stiffening brace or rib for each panel, and holding the entire hood base securely and accurately in place under all conditions of operation.

A 2-in. hole is provided in the center of each of the lower panels near the base for the insertion of draft tubes, consisting of $\frac{1}{2}$ -in. iron pipe; a damper is arranged to cover the hole when the draft pipe is not in service, being pivoted upon a single rivet. In addition to this draft aperture, every alternate panel is made up with an 8-in. hole for observation and utility purposes.

The upper section is composed of panels of sheet steel of No. 22 gage, similar in design and shape to the lower panels, with the same projecting lip and inverted U joint, and punched holes for bolting at the top and bottom of each joint. For connection with the corresponding lower section panels along the edge, on overlap of about $1\frac{1}{2}$ in. is provided, and fastened with tie bolts of V-shape design to effect a substantial bond between the two.

ADJUSTABLE SMOKESTACK

The smokestack, of sheet metal, is adjustable, and is supported by a metal band at the base and top of the cylinder. Lugs are riveted to the stack at the bottom for attachment to the upper section of the hood, four wires being passed through these lugs to form the connection. The exact circumference of this smokestack varies for the different number of panels used to make up the desired size burner. A 12-in. stack is employed with a sixteen-panel hood, a size of burner which has been found to be the most suitable and practical for ordinary service.

In erection, the lower panels are bolted together in groups of two, three or more to facilitate handling and moving. Following, the different groups are placed

around the stump area to be cleared and the remaining connections made with heavy cotter pins, thus permitting prompt dismantling and removal to other locations in the vicinity when desired. The roof sections are bolted together and the stack is attached before being placed upon and fastened to the base panels.

Prior to operation, the stump, or stumps, to be burned are cleared away sufficiently of dirt and debris at the roots to allow the kindling of a good fire. After the erection of the hood over the area, the fire is started by using the observation openings in the lower panels, while the draft pipes to be employed are inserted in position to render the best possible effect of the forced draft. The draft increases as the temperature rises under the hood, being augmented by feeding logs to the fire, as needed, after kindling.

The draft tubes are pushed in from time to time as the roots of the stump are consumed, while the number of tubes with which the hood is provided allows for a full play of the fire. The volume of hot air in the hood produces a constant and forced draft through each tube—a heat, however, which is not intense enough to affect the sheet steel hood, as the air supply is limited at the roots.

Recent tests on Washington timber lands show that this type of stump burner will consume stumps from 3 to 5 ft. in diameter, together with roots within the range of the burner, in a period of 24 hours, while larger stumps from 6 to 7 ft. are burned in 30 or 40 hours. In connection with a low first cost and operating expense, this stump burner offers particularly effective service in the field, both in installation and in removal to adjacent sites.

Reclaim Alkali Land by Simultaneous Flooding and Draining

Abandoned 150 Acre Tract in California Is Made to Produce Crops After Irrigating to Remove Alkali Salts

AN EXPERIMENT made to determine the effectiveness of flooding and draining alkali areas is the subject of a report recently issued by the Agricultural Experimental Station at Berkeley, Cal. Experiments were made on a 150-acre tract of land near Fresno, Cal., on which alkali was present to such an extent as to preclude its use for agricultural purposes. The results of the experiments are believed to have demonstrated the possibility of removing enough of the sodium salts to permit of the successful use of the land for agricultural purposes.

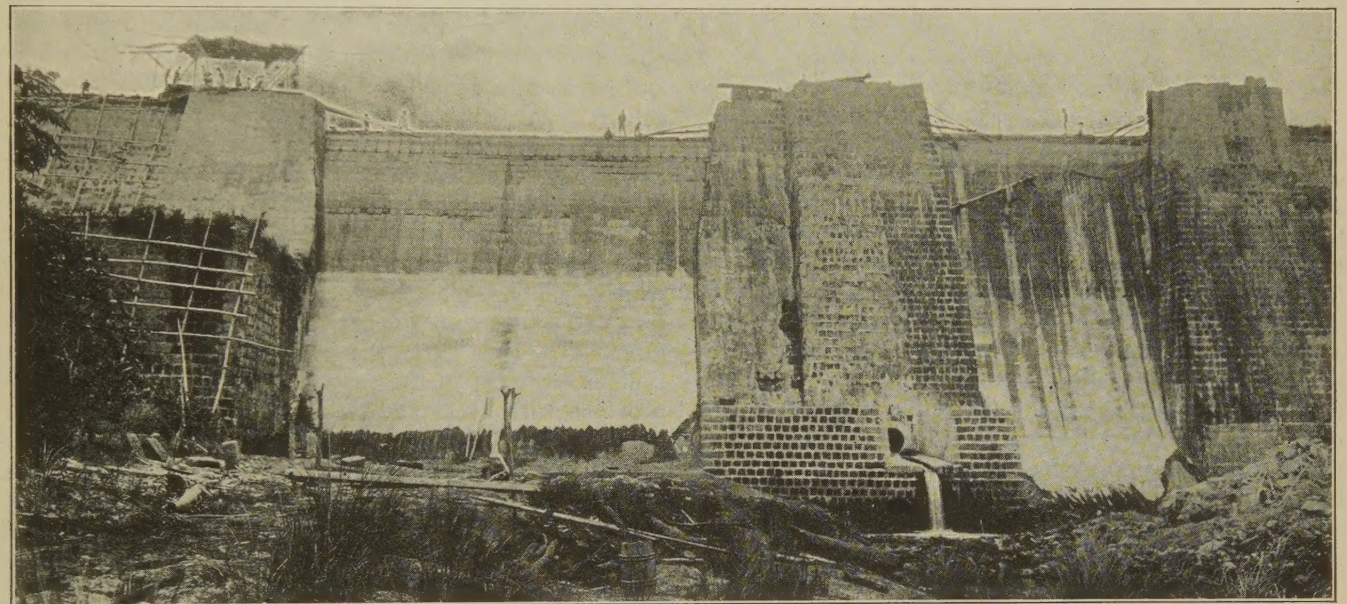
The land was first used about 1890, when a vineyard was set out upon it. A rising water table and the accompanying accumulation of alkali practically destroyed the vineyard. After this the land failed successively in producing alfalfa and grain. It was then abandoned and no crops were put in for several years previous to 1913.

Work on the drainage system commenced in 1913. The drains consisted of 6 to 12-in. tile, with a fall of 1 in 1000, placed at an average depth of about 7 ft. These drains discharged at the lowest point of the

tract into a sump, from which motor-driven centrifugal pumps removed the drainage water. After the drain tile was installed the canal system was put in shape and the irrigation checks were repaired at a total expense of \$66 per acre. The tract was then flooded intermittently to a depth of 6 to 12 in. After the flooding had been carried on during the spring season a crop of corn was raised which just about paid for the harvesting, indicating some progress in reducing alkali content.

PUMPS OPERATED SIX MONTHS

In the following spring the tract was again flooded. The pumps were kept in operation continuously from March to September, and in this time handled 145,000,000 gal. in 1915 and 160,000,000 gal. in 1916. Water put on the tract was not measured. The tests of the soil made in successive seasons showed the following



ADOBE BLOCKS SET IN LIME PLASTER PROVE HARD AND TOUGH IN TUNNEL EXCAVATION

average results, all of the soil samples having been taken from points within 1 ft. of the surface:

SODIUM SALTS IN SURFACE FOOT				
Year	No. of tests	Per cent NaCl	Per cent Na ₂ CO ₂	Total
1913.....	122	0.0972	0.0401	0.1373
1914.....	119	0.0276	0.0406	0.0682
1915.....	138	0.0208	0.0338	0.0546

The total cost of this work in the successive years amounted to \$100 per acre, but this is about \$40 per acre more than would be normally required, the report points out, inasmuch as about \$20 per acre was required for the eradication of Bermuda grass and about \$20 per acre was involved in duplicate expenses for pumping and tile that would be unnecessary with the proper design and construction on another tract of similar character.

During 1916 the tract produced 180 tons of grain hay, and is believed to be in such condition that alfalfa can be successfully grown in 1917. Further cultivation and irrigation, it is pointed out, will cause the alkaline condition to change still further for the better

Adobe Dam in Philippines Dewatered and Leaks Repaired

Irrigation System Threatened and Dam Rendered Unsafe—Work Carried Out by Bureau of Public Works

DEWATERING of an adobe dam in order to repair leaks in the upstream face was undertaken by the Bureau of Public Works, Philippine Islands, when leakage through and under the dam reached such a state as not only seriously to threaten the irrigation system, supplied by the impounded water, but also to put the dam in an unsafe condition. The repair work necessitated tunneling through the dam from the downstream face in order to dewater the reservoir, and consisted of building a wooden sluice gate, erecting a large buttress to strengthen the light gravity section of the dam, pro-

viding ample drains for seepage water, repointing seams and joints with cement-and-sand mortar, and building a curtain wall. The work was undertaken when the leakage amounted to 6 gal. per second, or 864,000 gal. per day. The work is described by C. R. Bennett, district engineer, in the quarterly bulletin of the Bureau of Public Works, Philippine Islands.

DAM BUILT WITH WEAK GRAVITY SECTION

The Tres Cruces Dam, as it is known, is located in the Cavité Province, about 4 miles up the Timalan River from Manila Bay. The present structure was completed in 1886, replacing another of the same type which was washed out in the seventies. It is, however, built with a gravity section so thin that buttresses on the downstream side and a clay bank on the upstream side had to be added later to make it more stable. One section 40 ft. long is 50 ft. high and only 20 ft. wide at the bottom. During the last few years the spillways have been badly damaged, one having been completely destroyed and the other about 40 per cent washed away. The structure was in such poor condition that the friar lands division of the Bureau of Lands appropriated \$15,000

for repairs, and requested the Bureau of Public Works to undertake the work. This was begun in December, 1915.

In order to stop the leaks in the face of the dam it was necessary to let the water out; and as no gate had been provided, a tunnel had to be excavated through the structure. This was located at the original stream-bed center, 46 ft. below the water line. The tunnel excavation was made 5 ft. in diameter and was lined with concrete to leave an opening 3 ft. in diameter. The adobe and lime mortar were so tough that never more than 3 lin. ft. was completed in 24 hours, although three eight-hour shifts, consisting of four men each, were employed. When the excavation reached the adobe on the upstream side the water was allowed to force its way through the clay bank and drain out. As this was going on, hundreds of natives gathered around with nets and buckets to catch the fish. It is estimated that at least 4000 lb. of fish and several hundred eels, some 6 ft. long, were caught.

SEAMS AND JOINTS CLEANED AND REPOINTED

After the dam was unwatered, every seam and joint on the upstream face was cleaned out and repointed with a 1:2 cement-and-sand mortar. A gate, made of 4-in. timbers, with a heavy, brass-bound frame, was built at the upper end of the tunnel. Two large buttresses were built, one between the spillways and one at the outer edge. The spillways were later surfaced with concrete. Ample provision was made to carry away seepage which might collect behind the concrete. In addition, a strong curtain wall was built across from the two buttresses at the outside edge of each spillway. All downstream joints in the masonry were then repointed. Finally an additional spillway was provided at one end of the dam.

Cost of Engineering an Extensive County Road System

On Work in Texas Totaling \$1,075,000 and Covering 178 Miles of Construction Engineering Cost Is 4.58 Per Cent.

By WILLIAM C. DAVIDSON

MCLENNAN COUNTY, TEXAS, has recently completed the construction of a road system consisting of 5 miles of concrete, 63 miles of waterbound macadam and 110 miles of gravel construction, entailing the building of 488 bridges and culverts. The total cost amounted to \$1,075,000, of which \$895,000 was expended on road construction, buying right-of-way, and defraying engineering expenses. Itemized cost records were kept throughout the work, and the following is a description of the items charged to engineering.

The center line of existing roads was followed as closely as practicable in running out preliminary transit lines, stakes being set at intervals of 500 ft. along one of the fence lines and hubs at all angle points. All data on right-of-way were recorded, including the distances from the center of the road to the fences on both sides, and stretches of road where no right-of-way existed were located. The size, kind and location of all bridges and culverts, character of the soil, the width and

depth of gravel on existing roads of this type, and the condition of the road with regard to drainage were noted. Wherever possible, the names of property owners were obtained and notes were made of the bearings and station numbers of side roads, fences and railroads. Data were secured from which the amount of clearing and grubbing might be estimated.

The level party followed the transit party, taking the profile of the center line of the road, the flow line of small streams and a ravine section of larger streams and creeks. Wherever it seemed necessary, the road was cross-sectioned and information was secured as to the extent of road subject to overflow during high water. For use in subsequent construction work, benchmarks were established at intervals of about one-half mile.

PRELIMINARY ESTIMATES MADE BY FIELD PARTY

As soon as the field data were obtained, the work of the entire organization was concentrated on the making of plans and estimates. This included a profile and alignment map of each road, a general map of the whole system, standard road sections and standard bridge and culvert plans. Tables were prepared showing the location and type of road to be built and the location, size and type of all bridges and culverts.

The organization as it existed during the field work of the preliminary surveys consisted of two field parties, each party having a level and transit organization. The transit party consisted of a transit man, two chainmen and a teamster who assisted in front and back flaggings. The level party was composed of a levelman and rodman, who, as in the case of the transit party, were provided with hacks and teams for conveyance over the roads. These outfits were owned by the county.

Work on the preliminary surveys, plans and estimates involved about two and one-half months, in which time 203 miles of preliminary line were run and plans and estimates made. The cost of this work amounted to \$3,014.30, or \$14.85 per mile. This is 0.28 per cent of the cost of the improvement, and included salaries, expense accounts of the men, cost of instruments, transportation, field books, tracing cloth and other material used in making up the preliminary estimates. The salary basis was as follows: Transitman, \$90 per month; levelman, \$75 per month; rodman, \$50 per month; chainman, \$45 per month, and teamster, \$50 per month.

CONSTRUCTION WORK DIVIDED BETWEEN TWO RESIDENCIES

The organization for handling the construction work consisted of a chief engineer, an assistant engineer for each of the two residencies, a general inspector for each of the five work divisions, two field parties, a bridge engineer, a chief clerk with one assistant, and a stenographer and material checkers, the latter varying in number in accordance with the demands of the work. Two divisions of the work were in one residency and three divisions in the other—the mileage of each residency being practically the same, and the cost of construction being about equally divided between them.

As the county furnished all the road gravel to the contractor, it devolved upon the engineering department to order this as the work progressed. Details of this work were carried out under the direction of the chief clerk, who was supplied with data as to the number of

cars needed each day by the assistant engineers or the inspectors. More than 300,000 tickets were issued for rock and road gravel, and since all such tickets were summarized in the office, it can be seen that this item alone involved no small amount of labor.

WORK OF BRIDGE ENGINEER

The bridge engineer was employed to design such bridges and culverts as could not be built in accordance with standard design. This work included principally the design of special overflow bridges and special I-beam bridges, occupying the designer's time for about three months.

Each assistant engineer as well as the county engineer was supplied with automobile transportation. Including the original investment for the cars, the cost of transportation amounted to \$4,164.53, or 0.39 per cent of the total expenditure. This figure seems comparatively high, but includes the cost of gasoline, oil, repairs and supplies, and part of it is traceable to the bad condition of the roads during the early part of the construction work. After much of the road had been completed the operating expense, except as to repairs, was materially reduced. The average drive per day per car was 50 miles. Each assistant engineer was required to cover practically 90 miles of construction work, some of which was situated more than 20 miles from the base. It would have been impossible to handle the field work without the use of an auto conveyance.

CHIEF CLERK IS CIVIL ENGINEER

The office organization consisted of a bridge designer at \$125 per month, a chief clerk at \$100 per month, an assistant clerk at \$75 per month and a stenographer at \$50 per month. The work of the chief clerk consisted in checking requisitions and accounts, ordering gravel to be shipped to the various spurs from day to day, compiling data for the monthly estimates and preparing drawings, maps and estimates incident to the construction work. Both the chief clerk and his assistant were graduate civil engineers, and hence could handle other than strictly clerical work. The total of strictly office expenses was \$6,520.18, or 0.61 per cent of the total expenditure, and included not only salaries, but drafting supplies, stationery, printing of all blanks used for reports and estimates, blueprinting and all other miscellaneous expenses.

With the aid of the data prepared by the office force the assistant engineers drew up the monthly estimates, and were responsible for them. These estimates were then passed to the county engineer for his approval. The assistant engineers had personal charge of all field work, and in general supervised the construction work under the advice of the county engineer, though the detail work was left largely to the inspectors who were required to make daily, weekly and monthly reports of the work under their charge. They had general charge of all the road and bridge work, except the running of lines, cross-sectioning for earth work, and the staking out of bridges and culverts.

All transportation for inspectors was furnished by the inspectors themselves. It was the further duty of the inspector to measure foundation excavation for bridge work and to classify it in accordance with the standard for this work. Furthermore, the inspectors assisted in

making out the monthly estimate, and computed all bridge and culvert work, though the earth work, clearing and grubbing was handled by the assistant engineer and his instrumentman, and the gravel and rock totals by the office force. Material checkers were employed under the direction of the inspectors to issue tickets for the rock and gravel delivered on the road and to see that a scheduled amount of each was placed at each station. The number of checkers depended on the extent of the outfits hauling material.

The total construction expense, including salaries of men and expense accounts, amounted to \$21,975.56, or 2.04 per cent of the total cost. A total of 508,000 tons of road gravel and stone was used in the construction of the system, and the cost of checking these materials amounted to \$9,171.07, or 1.8 cents per ton, which is 0.85 of 1 per cent of the total expenditure.

WHAT IS MEANT BY "ENGINEERING COST"?

The total field expense, including salaries of men and expense account, amounted to \$21,975.56, or 2.04 per cent of the total cost, while the total construction expense, including office, transportation and field, amounted to \$32,396.27, or a percentage of the whole of 3.01. This does not include material checkers, who should not be classed as engineers, but whose cost should perhaps be charged against material. The schedule of salaries going to make up this total, but not given before, is as follows: Assistant engineers, \$150 per month; inspectors, \$100 per month; material checkers at the rate of \$2 per day, or when employed on straight time \$45 per month.

The following is a summary of the engineering cost:

Items	Per cent of total cost
Preliminary surveys	0.28
Office expense	0.61
Transportation	0.39
Salaries and expenses.....	2.04
Total	3.32

If the county engineer's salary be figured for the length of time elapsing between the beginning of the preliminary surveys and the completion of the work, the cost will be increased by 0.41 per cent of the cost of the work. This added to 3.32 per cent gives a total of 3.73 per cent. If we should go a step farther and add to the foregoing percentage the percentage cost (0.85 of 1 per cent) for checking material, we should have a total cost of 4.58 per cent, which amounts to \$35,155.57, or an engineering cost per mile of \$197.50.

The chief engineer of the project was Rollen J. Windrow, of Waco, Tex., who is serving in the capacity of county engineer and road superintendent of McLennan County, Tex. Associated with Mr. Windrow as assistant engineers were J. M. Isbell and the writer, the former being in charge of Residency 2 and the latter in charge of Residency 1.

Claims 1,000,000 Hydroelectric Horsepower

Hydroelectric-power resources available for the city of Los Angeles total 1,000,000 hp., according to statistics recently published by the Bureau of Power and Light of the Los Angeles Public Service Department.

State Road Legislation Reviewed by American Highway Association

Complete Study of Subjects Which Should Be Considered in Laws Relating to State Highway Departments

ONE of the great social and economic problems facing the country is to increase the products of the country and to decrease their cost to the consumer. The two aims are not antagonistic. Better farming will produce better and larger crops with the same expenditure of money and labor, and better marketing facilities will reduce the cost of delivering farm products to the consumer. Better farming and better marketing depend on better roads. The average cost of hauling farm products over average country roads was found by a comprehensive investigation by the U. S. Department of Agriculture to be 23 cents per ton-mile, while the average cost of hauling over hard surface roads should not exceed 13 cents, and it is the townsman, not the farmer, who pays that 10 cents per ton-mile tax due to poor roads, according to R. Walton Moore, who was requested by the American Highway Association to make a study of the laws of the various states relating to highway departments, so that future legislation in the different states might be so drawn as to make possible the most easy method of constructing state roads. The following matter is extracted from his report.

POINTS TO REMEMBER IN ADJUSTING ROAD LAWS

For years to come a very large proportion of the roads in the country will remain under local control, and public interest requires that control to be of a high character. It will prove helpful in any adjustment of state road laws to determine broadly, first, what roads shall be put under the control of the state highway department; second, how these roads shall be selected; third, how the responsibility for the improvement and maintenance of these roads shall be divided between the state and its subdivisions; and, fourth, the organization and financing of the state highway department to discharge the duties assigned to it. When this is done, the laws relating to the remaining roads of the state should be reviewed to make sure that the new legislation does not unintentionally effect harmful changes.

While each state must decide for itself what duties shall be assigned to its highway department, and the detail with which the law shall prescribe the procedure to be followed by the department in the discharge of its duties, it is well to keep in mind that if such a department is to be held responsible for results it should not be hampered by restrictions upon the methods it may adopt to obtain such results.

CO-OPERATION WITH LOCAL BOARDS OF GREAT HELP

Although the highway department should be authorized to make all necessary surveys, the department should be authorized to call upon local boards for help in ascertaining the travel on roads. The Ohio law on this subject reads as follows: "The state highway commissioner or chief engineer may call upon the county highway superintendent to furnish maps of the county

showing distinctly the location of . . . public highways and deposits of road material, together with any other information that may be required by said commissioner or engineer. . . . The county highway superintendent shall have the right to call upon the township trustees or township highway superintendents to furnish any part of the information."

LEGISLATURES SHOULD NOT SELECT STATE ROADS

Opinions as to the necessity for simplicity of action vary considerably in different states. For instance, in Pennsylvania the main roads are designated by the legislature. As a result of this method there are 10,200 miles of Pennsylvania roads designated as state highway. The result is that during 1915 the department spent about \$4,500,000 in maintaining this mileage, and during 1916 it spent about \$3,000,000, with nothing of any great moment in the way of permanent improvements to show for it. Had this money been spent on a smaller mileage it would have furnished a satisfactory nucleus to the permanent highway system of the state.

On the other hand, in Illinois the highways receiving state aid are selected by the county officials, subject to revision by state highway commissions. This is somewhat better than the method adopted in Pennsylvania, but not so good as that in force in Massachusetts, where state highways are designated by the highway commission upon petition of local authorities.

No haphazard, disjointed method of improving main roads without a definite plan by which the work of to-day will eventually become a part of a complete system of highways will prove satisfactory. Secretary of Agriculture Houston placed stress on one important aspect of this in the following statement: "In accepting the terms of the Federal Aid Road Act, the state, as a matter of course, pledges its faith to the five-year program. This is important because it makes possible the arrangement of a comprehensive scheme of road-building." Where state funds are contributed to work done by local officials, the state department should be authorized to withhold state aid until the local authorities have provided satisfactory rights-of-way.

PROVISION FOR CAREFUL PLANNING SHOULD BE EMBODIED IN ALL LEGISLATION

The advantage of concentrating authority in a single commissioner is that a good administrator can accomplish more than a mediocre board, and it may be not so difficult to obtain a good administrator as it is to obtain a harmonious, energetic and capable board. On the other hand, a board composed in part of state officials and in part of civilians, including professors of engineering in state colleges, is perhaps more likely to be free from individual predilection, in closer touch with public opinion in different parts of the state, and apt to take a broader view of problems because relieved of direct responsibility for detail. However, excellent work is being done under both systems of administration.

In a number of states the highway commission consists of three or more state officials. In other states, the board consists of a few state officials acting with professors of engineering in state schools, and occasionally with two or three private citizens appointed

by the governor. In other states all the commissioners are private citizens. In many instances, the commissioners draw no pay but are allowed their actual expenses. Under any arrangement, however, the duties to be performed should be stated comprehensively and clearly in the law. The Ohio statute is a good example of this.

DUTIES OF STATE HIGHWAY DEPARTMENT OUTLINED

Among the most important duties of state highway departments as outlined by Mr. Moore are the maintaining of facilities for testing materials, collection of automobile fees and the issuance of regulations governing the use of vehicles on public roads, the investigation of the suitability of different types of road and bridge construction, the holding of public meetings to explain the desirability of road and bridge improvements, the preparation of standard plans and specifications for roads and bridges, the determination of the main roads of the state and the mapping of them, and the preparation of plans and specifications for roads and bridges built by the state and the supervision of their construction. In addition, the highway department should co-operate with local authorities in the following instances: Preparing or aiding in preparing plans for road and bridge improvements of a purely local nature; supervising and assisting in supervising construction and maintenance of roads under local officials; designating roads and bridge work on which state funds shall be spent; and the annual inspection of all bridges exceeding 30 ft. in length.

APPOINTIVE POWER WHERE RESPONSIBILITY LIES

As a general rule, a department works best when it has authority to organize its own staff, but there should be no question about the importance attributed by the legislature to efficient engineering. The following clause, in substance, is desirable in the law governing any state highway department: "The state highway commission shall appoint a state highway engineer, who shall be a competent civil engineer, experienced in highway construction. It may appoint, subject to the approval of the commission, such technical assistants as may be necessary for the proper conduct of the engineering work of the commission."

In many states the actual purpose of the state highway department is essentially regulatory and advisory. It is intended by the legislature to be a preventive of inefficiency on the part of local highway authorities, and this purpose is accomplished by two general classes of statutory requirements, the first governing the class of men placed in charge of road work by local authorities and the second requiring the submission of plans by the local authority to the state department for approval before work can be undertaken. The Illinois plan is excellent in this respect, providing that all road construction not done under the immediate supervision of the state highway commission shall be performed under men whose fitness it has determined by competitive examination.

ENGINEERING CO-OPERATION WITH LOCAL OFFICIALS

There is very little uniformity in legislation governing the co-operation of state highway departments with local highway officials. This is undoubtedly due to the

tendency of lawmakers to add the highway department legislation to existing road statutes. Any legislative committee instructed to draft laws for the organization or reorganization of a state highway department should also be empowered to report on amendments to existing laws relating to local roads. As an instance of excellent legislation of this sort, each Iowa county is required to have a county engineer, who may be removed for incompetency by the state highway commission as well as by the county supervisors.

A weak feature of the road laws in many states is the indefinite manner in which responsibility for bridges and culverts is stated. A considerable proportion of the highway bridges of the country are unsafe. In some laws the departments are directed to hold annually a specified number of public meetings to explain road affairs to taxpayers and to issue bulletins on road subjects for general distribution. In West Virginia, for instance, the department gives annually a special course of instruction in highway engineering, and the law requires all county engineers to attend this course for at least ten days each year.

Experiment with Groins at Santa Monica Beach Successful

Wood and Concrete Structures Are Effectively Building Up Sand Deposits—Certain Precautions Must Be Observed

A BATHING BEACH on the ocean front at the north line of the city of Santa Monica, Cal., has suffered serious erosion and sand losses each year since 1913. On the advice of an engineer, owners of the bathing resort decided to experiment with groins. Preliminary studies of the beach developed that although the contour above mean tide was very steep, below that elevation the beach was flat, with occasional long depressions. The first depression was parallel to the tide line and about 70 ft. from it, while others with less defined limits were farther out. The prevailing current in all of these depressions was down the coast and carried considerable sand. The prevailing wind is almost due west, while the shore line lies along a line bearing about north 45 deg. west.

FIRST GROIN EXPERIMENTAL

The first groin to be constructed was made as an experiment while the owners were still skeptical about the actual benefit that could be expected to result. For its construction a small pile driver was rigged up on the rear end of a light spring wagon, using for a hammer a 100-lb. section of a eucalyptus log. Five men provided the motive power for raising the hammer and maneuvering the rig on the beach. The driving was assisted by a jet of water from the city supply mains under a pressure of about 80 lb. delivered through a 3/4-in. nozzle on a 2-in. pipe. Where boulders were encountered, 4-in. pipe was used as posts, or 3/8 x 3-in. iron bars were driven to which the bottom board was bolted, and this in turn was bolted to the post which supported boards above. The joints between planks were covered with 1 x 4-in. battens.

Having been constructed in this comparatively haphazard manner, with a maximum penetration for the

posts of probably less than 6 ft., the structure could not withstand the stress to which it would be exposed on an unprotected shore line. Most of it was destroyed by rough weather about three weeks after its completion. However, in these three weeks the sand deposits had accumulated to a depth of 3 ft. on the windward side, and the success of the scheme had been proved.

CONSTRUCTING THE GROINS

With this encouragement, a gasoline-engine-driven pile driver with a 700-lb. hammer was put into service, working from a temporary trestle, and the three other groins shown in the accompanying photograph were built. The construction consisted of two 4 x 4-in. posts, 6 ft. apart, to which 4 x 12-in. planking was bolted. The timber was Oregon pine, and was promptly attacked by marine borers, so that its life will probably be very short.

One of the chief construction difficulties was getting the bottom plank to the necessary depth. On account

but the high groins caused a deposition of sand only on the up-current side. As each wave sweeps along the beach and over the groins, the height of the drop gives the water a force sufficient to sweep away the sand which would otherwise deposit on the down-current side. In addition to the irregularity of the beach, the exposed high groins are unsightly. Both these disadvantages could have been avoided by building up the groins gradually, board at a time, as the sand accumulated on both sides.

CONCRETE PLACED BETWEEN POSTS

It was found almost impossible to keep the seaward end of the groins tight, so concrete was placed between the posts for a height of 1 to 2 ft. above sand level. This has served the double purpose of anchoring the posts and keeping the joints tight.

Since the new groins have been put in several severe storms have occurred, but the only damage caused resulted from piles which have broken away from the



ARROWS SHOW BEACH LINE BEFORE AND AFTER USE OF LOW GROIN

of the short time during which work could be carried on at low tide, and the number of boulders encountered at this level, great care was required to prevent leaving a small space under the board. At least one plank had to be below sand level, it was found, for if there was any chance for the current to cut underneath this would be enlarged until the entire seaward end of the groin would be above sand level and of no service until another plank could be placed below the one previously put in.

NECESSARY PRECAUTIONS

Another point which required careful attention was the placing of battens, for even a small crack between the planks was fatal to the success of the scheme. Even the hole left by withdrawing a misplaced $\frac{3}{8}$ -in. bolt would cause extensive damage. The water would spurt through this hole and would dig out a crater 8 or 10 ft. in diameter on the up-current side of the groin, and this would destroy the action of the groin to seaward. Once the groin was tight, however, the action was rapid and new plank could be placed almost overnight.

As reconstructed, the experimental groin was built eight planks high at the shore end, adding the planks as the beach built up. The other groins, however, on account of the impatience of the owners, were built high as soon as the first two boards had been covered, the desire being to build up the beach along shore with the greatest possible rapidity. The desideratum, which was a flat playground for bathers, was accomplished,

long wharf and floated against the groins. They battered away about 20 ft. from the end of groin No. 2 and about 20 ft. from its central portion. The gap was replaced by a concrete wall.

These storms came from the south and seemed to cause a reversal of the littoral drift which took away the sand deposit for about 20 ft. at the outer ends of the groins. This checked up previous observations, which indicated that south and sometimes southwest winds set up a "scouring tide" as a result of which the outer 20 ft. of the sand deposits are not considered permanent accretions.

Summing up the result of experiment and observation thus far on this work, it may be said that the groins must begin above highest water line; the bottom must be at least 6 in. below sand level and the entire groin absolutely watertight; that it does not pay to use perishable construction materials; that the impatience of owners must be restrained, keeping the groins low and building them up as the beach develops; and that the first groin to be constructed should be on the down-current end of the beach.

The foregoing notes and observations have been supplied by Wilkie Woodard, civil and landscape engineer, of Los Angeles, who induced the owners to experiment with groins. Mr. Woodard's recommendations for permanent groin construction have not been carried out, but the experimental work and the temporary construction have afforded encouragement for more stable structures which will probably be built.

Save Shop Costs and Insure Economy by Proper Design Details

Complete and Comprehensive Design Drawings Advocated—Advantages in Uniformity of Sections and Duplication

THAT design drawings should be complete and comprehensive in order to save time and misdirected effort in the drafting room and allow early ordering of material; that economy results from simple designs with uniformity in the structural units and details; that as few sections as possible varying by relatively large thicknesses should be adopted throughout a given design, and that simple splices should be used are the principal points made in a discussion of "Factors Affecting Costs of Structural Steel Shop Work," by E. W. Pittman, manager, McClintic-Marshall Company, Pittsburgh, and G. H. Danforth, structural engineer, Jones & Laughlin Steel Company, Pittsburgh, before the Engineers' Society of Western Pennsylvania. From the December *Proceedings*, where these two papers and the opinions of several members are given in full, the following abstracts have been taken.

GENERAL DESIGN DRAWINGS SHOULD BE COMPLETE

When the design drawings, said Mr. Pittman, are complete and comprehensive, much time and misdirected effort are saved in the drawing room. If time permits, it is customary to make the shop drawings and check them before compiling a list of the steel required. Generally, however, it is necessary to order the steel from the rolling mills promptly, using a few preliminary sketches and layouts. If the mill order involves a great variety of shapes, a considerable period sometimes elapses between the beginning and the completion of deliveries from the mill. This, of course, enhances the difficulty of storing the steel and having it accessible for use in the shop at the time when final delivery is accomplished. It is not economical, as a rule, to start the fabrication of a structure until all the steel is delivered.

The largest single factor, according to Mr. Pittman, in determining the cost per pound of steel in a structure is the design rather than any special or unusual requirements as to workmanship. If utility and economy are the governing considerations, the design should be as simple as possible. The number of members and the number of pieces in each member should be reduced to a minimum. Complicated connections and splices and bent work should be avoided as far as practicable. The use of a great variety of sections and of sections not often rolled should also be avoided.

USE STANDARD SECTIONS

This is especially important, he said; if quick delivery is a consideration, as it is easier to procure mill rollings of a few standard sections than of a great many, including some unusual ones, such as T-beams, Z-bars and deck beams. It is always well to go over a design after it is finished and make a list of the different kinds of sections shown. Generally it will be found possible greatly to reduce the number without materially increasing the weight.

In ordinary structures, such as small bridges, viaducts

and buildings, Mr. Pittman thinks it best to make liberal use of beams, channels and H-columns in place of short lattice struts and trusses and built-up columns. Designs made up of fretwork of such lattice members and plate-girder crane runways may be redesigned in the interest of economy with H-columns in place of built-up columns, beams in place of roof trusses and lattice struts, and girder beams in place of plate-girders. The cost per ton to the purchaser for the manufacture of the original design, exclusive of the cost of steel, might be about \$15 to \$18, while the cost for the revised design should be about half this amount. Of course, the substitution of rolled sections for built-up sections sometimes increases the weight slightly. Using these figures as a basis of calculation, however, and knowing the base price of steel at any time, it is an easy matter to determine just what increase in weight would be compensated by the decrease in cost of fabrication.

In the design of shallow plate girders, according to Mr. Pittman, it is sometimes economical to increase the thickness of the web plate 1/16 in. beyond the thickness required to resist the shearing stress when such increase renders it possible to dispense with stiffener angles and fillers that would otherwise be necessary. Likewise, it is often economical to distribute column loads over a masonry footing by means of a thick slab rather than by means of a number of stiffener angles, wing plates and diaphragms at the base of the column. Stiffeners at the bottom of a column require careful planing and fitting to be effective, and frequently involve many hand rivets.

REAMING OF IMPORTANT FIELD CONNECTIONS

In bridge work it has become common of recent years, said Mr. Pittman, to require the assembling and reaming at the shop of important field connections, or else the reaming of such connections through a steel template. This adds considerably to the cost of fabrication, but it generally saves more in the field than it costs in the shop. This requirement should not be made, however, without a careful study to determine its economy. Sometimes a connection may be reamed cheaper in the field if it is easily accessible without scaffolding.

One of the important points brought out by Mr. Danforth is that it seems impossible for some people to make details without getting rivets into pockets, where they are very difficult, if not impossible, to drive; or without building up a section which has to be partly assembled and partly riveted before the remainder of the sections can be put together and the piece finished. There is also a tendency to use an excessive number of rivets. A few excess shop rivets are not serious and do not appreciably increase costs unless the excess is great. The contrary, however, is true in regard to field rivets. Frequently field rivets are put in with a free hand, utterly regardless of what it will cost the erector to drive them.

GOVERNING PRINCIPLES

In the discussion, Samuel E. Duff, consulting engineer, of Pittsburgh, listed the governing principles as follows: Uniformity of design; use of easily obtained and competitive material; standardization of details; selective control of shop operations, and technical administration of erection work.

For several years the system of selective control, or

standardization of operations, he continued, has been highly developed in many industries where enormous numbers of exactly similar things are produced, such as the automobile, the electrical apparatus and the agricultural implement industries. Practically to apply these principles to a business like the fabrication of structural steel, it is only a matter of adopting the proper yardstick by which the standardization is to be applied. Some excellent results have lately been obtained in this way and a great advance will be made along this line in the next few years. The tendency now is strongly toward the placing of this matter in the hands of engineers, and all engineers employed by fabricating companies should make it their business to study the principles of selective control and standardization of operations.

The application of the fifth principle, technical administration of erection work, said Mr. Duff, has been a slow but steady growth. It has come about largely through the fabricating and erecting contractors, who are now often called upon to handle enormous weights, and to put together large structures within close limits of measurement and within the shortest possible time. Efficient machinery and technical methods are being frequently employed on small jobs, and engineers have a wide opportunity to reduce the cost of erection by these means.

Mr. Danforth does not favor the making of elaborate drawings by the owner's engineer. He believes that while some clients imagine that because an engineer makes elaborate drawings he should be paid a higher fee, the investors are now beginning to learn that the man who gets results is the man who should be paid, regardless of how much time or drawing paper he uses.

Calls Hydrogen in Oxyacetylene Tanks Dangerous

After Investigating Causes of Explosions California Commission Limits Hydrogen Content to 2 Per Cent

DURING July of last year there occurred in California, within three days of one another, three explosions of tanks used in oxyacetylene welding work. The accidents caused the deaths of seven men and seriously injured five others. An investigation was immediately undertaken, as a result of which it was urgently recommended that no oxygen containers be used in which there was present more than 2 per cent of hydrogen. The entire story of the investigation, which was conducted under the direction of John R. Brownell, superintendent of the department of safety, Industrial Accident Commission, has just appeared in the first issue of *California Safety News*, from which the following has been taken.

All three explosions occurred in tanks of oxygen supplied by the same manufacturer, who had used what is known as the "electrolytic" method in obtaining oxygen. Each explosion occurred immediately after a new tank of oxygen had been put in use, and all were found to be due to the presence of an explosive mixture of gases in the oxygen tanks. The pressure in the three tanks varied from 350 to 2200 lb. per square inch. Five other tanks were recalled from customers to whom they had been shipped by the same manufacturer. The con-

tents of these tanks were carefully analyzed, with the following results:

Tank Number	Per cent O ₂	Per cent H ₂	Per cent CH ₄	Per cent N ₂
X10980.....	99.5	0.6	0.1	0.4
X11063.....	54.25	42.5	0.53	3.18
X13553.....	28.3	69.0	0.30	2.43
X 9233.....	42.3	52.55	0.6	4.6
X10789.....	41.05	55.0	0.48	2.98

The investigation developed the fact that while these tanks were being filled it was necessary to make repairs to one of the electrolytic cells at the company's plant, and one of the repairmen accidentally interchanged the feed-line connections of a set of twenty cells, causing the poles to be reversed, and resulting in the mixture of hydrogen with the oxygen which went to the container from which the tanks that later exploded were filled.

COMMISSION'S RECOMMENDATIONS

The commission pointed out that oxygen manufactured by the liquid-air process does not contain hydrogen. If oxygen manufactured by other processes is used it should be ascertained that the hydrogen content be less than 2 per cent. The user of oxygen made by the electrolytic process, the commission recommends, should satisfy himself that the following precautions are taken by the manufacturer:

1. Every electrolytic oxygen plant should be equipped with a system of purifiers, the purpose being to eliminate, as far as practicable, the presence of hydrogen in oxygen.

2. All electrical connections should be so constructed that they will be non-interchangeable.

3. A device should be installed for the purpose of preventing reversal of current between the generator and the cell connections.

4. High-pressure gages should have safety relief features.

5. Tests of both hydrogen and oxygen should be made every two hours where the capacity of the system exceeds 100 cu. ft. per hour. This test should be run alternately with gas obtained from the gas holder and from the line between the cells and the gas holder. (The purpose of the test is to check up the gas being shipped out and also the gas which is going into the gas holder.)

6. Each plant should have gas holders of sufficient size to take the capacity of the plant for at least two hours.

7. All hydrogen tanks should be provided with fittings which are non-interchangeable with those of the oxygen tanks. It is recommended that the former be left-hand fittings and the latter right-hand fittings.

8. Each cell should be equipped with a "relief" feature, the purpose being to safeguard against back pressure.

9. A complete record of each test, as well as any important features connected with the process, should be kept and turned over to the management or authorities competent to examine it.

10. A competent operator should have supervision of the plant. He should be thoroughly familiar with the making of tests and the reconstruction of cells, and should be sufficiently acquainted with electricity and its application to electrolytic oxygen manufacturing competently to take care of any disturbances.

Twin 100,000-Gallon Tanks Designed with Spherical Bottoms

Atlanta Warehouse Company Tanks Under 37-Foot Head Are 158 Feet High—Punched Steel Plates Used at Construction Joints

SUPERIMPOSED twin reinforced-concrete tanks for the Atlanta Warehouse Company, each of 100,000-gal. capacity, supported by a four-story tower, making the total height above the foundations nearly 160 ft., form one of the most unusual structures of this type in the country. Two coats of water-gas tar applied in connection with a dense gravel concrete mixed in the proportions 1:1½:3 were found to produce watertight tanks. Cantilever balconies at two levels are provided, and access to the top of the tanks is attained by an outside spiral stairway of reinforced concrete cast independently of the tanks and supported by cantilever brackets at intervals of about 15 ft. horizontally. Construction joints are made tight by 18 x ¼-in. steel plates punched along the outer edges to give good bond with the concrete.

These tanks are used to supply the sprinkler system for the reinforced-concrete cotton warehouses covering an area of 40 acres.

GENERAL DESIGN DATA

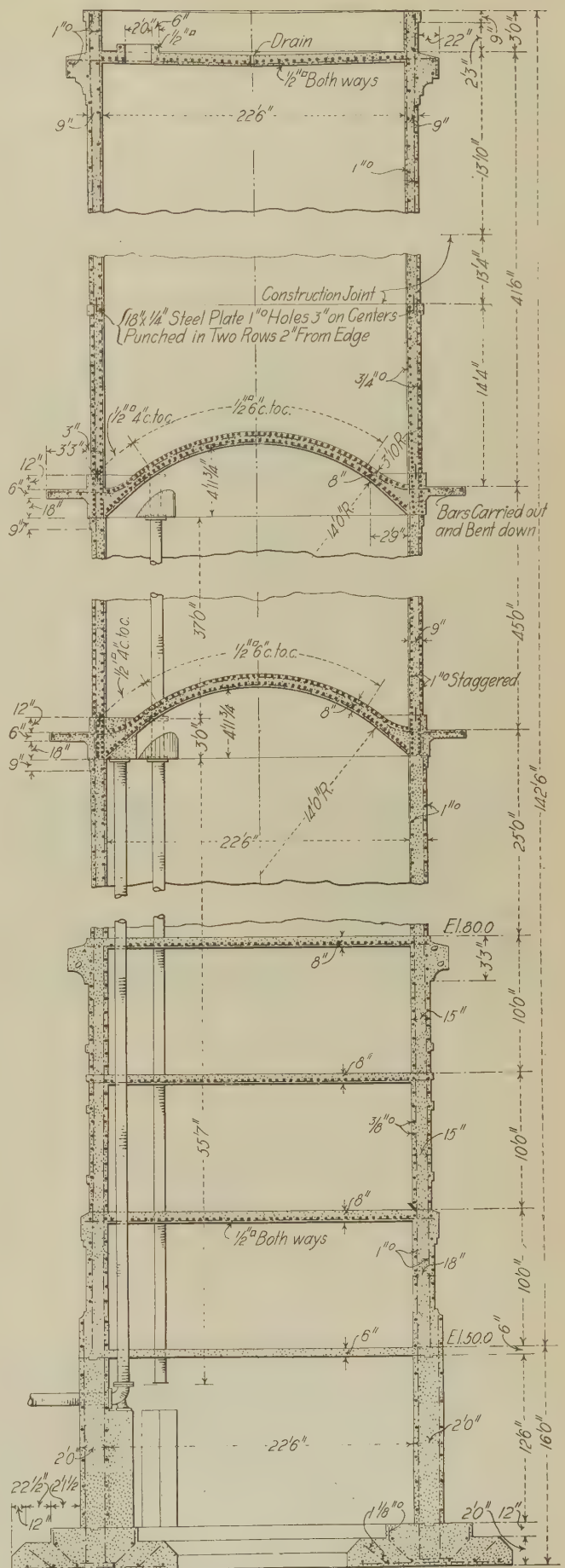
The allowable working stresses in steel and concrete were specified at 16,000 and 400 lb. per square inch respectively. The foundation soil, a stiff clay, was considered capable of supporting 2½ tons per square foot, after being leveled up with grout before the reinforced-concrete spread footing was poured. Wind pressure was considered at 30 lb. per square foot of the diametrical area for the cylindrical surface.

Usual design formulas for cylindrical containers were applied in the design of the 9-in. concrete walls of the tanks, assuming the steel to carry all the tension and varying the spacing of the staggered 1-in. circumferential rods from 3¼ in. at the bottom to 12 in. at the top of the tanks, which are 37 ft. deep. Vertical ¾-in. rods inside and outside are clamped at joints by two 1-in. cable clamps. A parapet and a cornice are furnished at the roof, as indicated on the drawing.

The design of the spherical tank bottoms was based on the theoretical analysis of Rankine's hydrostatic arch applied to dome theory. The reinforcing steel is circular and radial, the radial steel varying in length and stopping at four different distances from the center. These radial rods are ½ in. round, spaced 6 in. apart at the circumference (22 ft. 6 in. diameter). The circular ½-in. rods are continuous, wound in the form of a spiral, and clamped with ½-in. cable clamps, two to each lap.

CONCRETE PLATFORM AROUND TANKS

As seen on the drawing, the upper radial rods extend outward 3½ ft. and bend down 4 in. into a concrete platform carried around the bottom of each tank. The weight of tanks and water is carried by the walls of the tower, varying from 12 in. at the top to 24 in. in thickness at the foundation. Doors and windows are provided in this four-story part of the structure for the offices. The walls are reinforced vertically by 1-in. rods between windows, forming in effect eight columns below

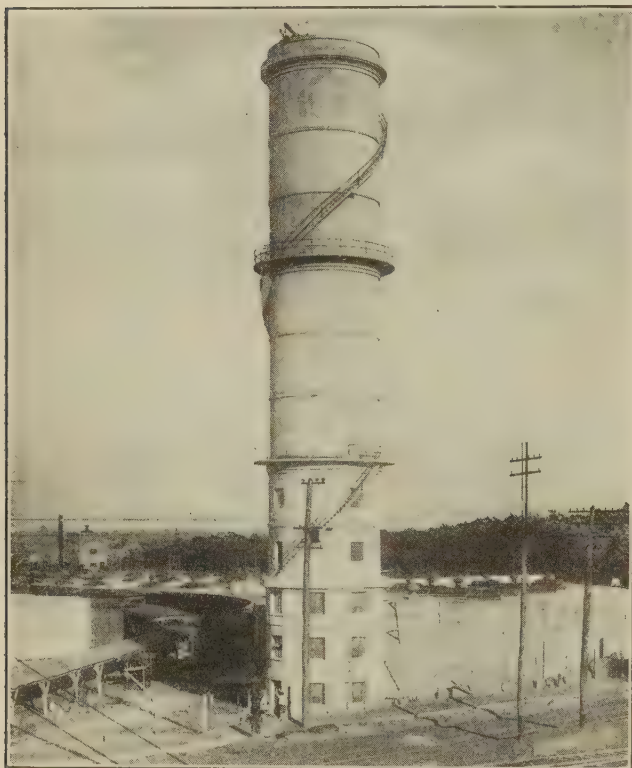


CROSS-SECTION OF TANKS AND TOWER, SHOWING REINFORCEMENT AND SPHERICAL BOTTOMS

El. 80 down to the ground floor at El. 50. The story heights are 10 ft., except the top floor, which is of 25 ft., the latter used for the purpose of storing the records of the warehouse company.

SPIRAL STAIRS—CONSTRUCTION JOINTS

Winding around the outside of the tower above El. 80 is a spiral stairway of reinforced concrete 1 ft. 7 in. wide, with $7\frac{1}{4}$ -in. treads and 8-in. risers, reinforced by $\frac{3}{4}$ -in. rods. This stairway is supported at the cantilever balconies and at intermediate points by brackets 15 in. wide and 12 in. deep connected to the walls of the tanks by four bent $\frac{3}{4}$ -in. rods. These brackets are



SUPERIMPOSED TWIN TANKS AND TOWER 158 FEET HIGH

spaced about 15 ft. apart horizontally and 13 ft. vertically, corresponding with the construction joints.

Construction joints occur at about 13-ft. intervals in the tanks, and in order to insure watertight conditions an $18 \times \frac{1}{4}$ -in. steel plate was punched with 1-in. holes 2 in. from each edge and embedded half in the concrete below and half in the concrete above. The holes increase the bond between concrete and steel, and the joints have shown no evidence of leaks.

WATERPROOFING USED

The concrete is a $1:1\frac{1}{2}:3$ mix, with gravel not exceeding $\frac{3}{4}$ in. in size for the large aggregate. The tanks were painted on the inside by two coats of water-gas tar—the first coat a thin grade and the second coat a heavy grade. The first coat was used as a primer and to prepare the surface for the second coat. The concrete has shown no evidence of leaking under full head of water in the tanks.

The design was made by E. A. Stuhrman, designing engineer for Arthur Tufts, contracting engineer of Atlanta, Ga. The contract was let on a percentage basis. The tower was completed last year.

Engineers Finding New Field of Activity

Abstract of Prize Paper on "Engineering and Civic Progress" Points to Increased Appreciation of Engineers' Worth

NEW FIELDS for engineers and their special fitness for them were discussed in a prize paper on "Engineering and Civic Progress" by Harvey T. Hill of Chicago. The prize, \$50, was offered by Subdivision 63, Engineers, Chicago Association of Commerce, in the hope of developing the relationship of the engineer and of engineering to the business and professional world and of determining how best to realize the conceived ideal of engineering. The judges were Prof. F. H. Newell, Dean John F. Hayford and John W. Alvord. Mr. Hill's paper opens with the query, "What is an engineer?" He answers it with the classified qualities with which Prof. C. R. Mann of the Carnegie Foundation stirred the profession to action. An abstract of the paper follows:

A WRONG IMPRESSION

Too often, says Mr. Hill, men are of the opinion that the duty of the engineer is to be a student and master of things, and that he does not need to possess a forceful personality combined with executive ability. How such a false cloak as this could have been enveloped about our engineers is a puzzle.

A feeling is becoming prevalent that the same plan of careful forethought which has solved problems of engineering should be applied to a wider field. The old idea was that the place for the engineer in the solution of civic problems was that of an adviser. He was considered a good man to consult once in a while, but should not be given power to execute his expert knowledge. Quite often those who went to him for advice were not competent to appreciate the valuable information he could give. This attitude is changing, until to-day we find the engineer being placed in positions of responsibility where he executes as well as plans for civic improvement.

FILL POSITIONS WITH EXPERTS ONLY

Horace J. Bridges said in a recent talk before the ways and means committee of the Chicago Association of Commerce on the subject "Can Efficiency Be Combined with Democracy?" that there should be laws passed in the United States analogous to those passed in Germany, allowing only those men to be candidates for office who have special expert training fitting them for that office. He also said: "Expert equipment for the particular job to be undertaken is what makes a real democracy. Who would think of the head of a health department being other than a doctor? Who would think of a state's attorney being other than a lawyer?" It is a pleasure to say that these positions are generally logically filled as far as the profession of the one chosen is concerned.

What about the commissioner of public works? Who ever heard of such a commissioner in Chicago being an engineer? What about Chicago's Board of Local Improvements? Who ever heard of an engineer being on that board? Yet its work is of an engineering type and demands the service of an experienced engineer rather

than simply an expert politician. Still another class of misfits are our county commissioners, who have charge of awarding thousands and sometimes millions of dollars' worth of construction, highways, bridges, etc. Here again the chair of the frank, honest, uncompromising engineer is filled by the clever politician. The recent appointments by the State of Illinois to the new public utility commission illustrate this point perfectly. Had it not been for the persistent efforts of the Western Society of Engineers there would not have been placed a single engineer on the commission. As it was, one engineer was appointed.

Those few fields that have been mentioned typify well how our present form of politics in many cases retards the efficiency of our government. As one passes over these facts he is led to ask whether the ever-increasing cry for efficiency will not soon bring about a decided change that will put the right man in the right place.

When our attention is diverted to the newer developments of civic life it is found that better conditions exist and that the engineer is receiving more nearly his just dues.

CIVIL SERVICE ELIMINATES THE UNWORTHY

Civil-service examinations tend to accomplish, in the departments in which they are held, the end which Mr. Bridges pleads for in all civic positions—which is to fill every position with an expert. The scope of civil service, as it is related to engineering, is broadening each year.

Large and small corporations demand special fitness in behalf of their employees. If such is the ideal of business, it should, and will, eventually become the ideal of political and civic life.

The city-planning systems which have recently been developed and are being developed impress upon us the dependence of civic progress upon the engineer. It requires an engineer's mind to plan new transportation systems, new street systems, new parks and other places of recreation. Without a plan it is impossible for you to execute.

The incorporation of the city manager into the list of city officials has opened a new field of public usefulness to the engineer. In the search to find the most capable men to fill these important positions the engineering field has been the hunting ground. In the majority of cases it has been the men of engineering training and experience who have qualified to carry on the work. Dr. Frank Crane emphasized this thought in a recent article on "The Engineer" when he stated: "We need the engineer to manage a city as economically and smoothly as if it were a manufacturing plant."

THE ENGINEER IN CHAMBER OF COMMERCE WORK

At the present time civic improvement is one of the outstanding activities of the chambers of commerce of the American cities. Many of the comforts of life we enjoy exist as a result of the never-tiring labor of some of the most prominent business men through the medium of chambers of commerce. The civic use, yes the civic necessity, of the chambers of commerce insures the prominent position these bodies are to hold in the future. Their organizations are of recent development and are free from traditions and customs of a time

that is out of date, such as often hamper civic and political organizations.

Many of the accomplishments of the chambers of commerce have been credited to the efficient work of the engineering members or to the engineers in the employment of the chambers. Of the latter class the New Orleans Association of Commerce and the Chicago Association of Commerce stand out as the leading examples.

The promoters of the association at New Orleans recognized in the engineer more than a builder of bridges, dams or machines. They saw in him a community builder. As the engineer expresses it: "Those with problems to solve have come to the appreciation of the concomitant imagination, ingenuity and good judgment of the man of well-rounded engineering education and experience with the ability to visualize the abstract and plan and execute it into the concrete."

HANDLING ENGINEERING COMPLAINTS

Although the industrial engineer can serve the cause of civic progress in an indirect way by helping to adjust the industrial misfits of his city, other classes of engineers often aid in a less roundabout way. The Chicago Association of Commerce has an engineering staff that has been working along direct lines upon special civic questions. In 1911 this association first employed an engineer, Louis A. Dumond, who at present handles all engineering complaints and inquiries or work of an engineering nature. Five short years ago the engineering staff of the Chicago Association of Commerce consisted of a temporary appointee to aid a specific committee, while to-day two civil engineers scarcely find time to complete the work they are called upon to perform.

One of the early undertakings of the committee on downtown streets was to study the various methods of locating and maintaining public utilities. The large number of holes, especially in the downtown section of the city pavements, influenced the committee to make a thorough investigation of what other parts of the world were doing to reduce to a minimum the number and the frequency of these disagreeable openings.

The lack of proper lighting in the business sections of Chicago was realized by the Association of Commerce. As a result it became instrumental in greatly increasing the light on Dearborn Street from Lake Street to the Dearborn Street station.

INSPECTION OF NEW PAVING

The Chicago Association of Commerce is the only association of its kind that takes an active interest in the inspection of the new paving in the city it represents. A small portion of its citizens realize the service that is rendered them by the engineers of the association. A member of the engineering staff inspects the material on each new section of street paving, as well as the workmanship of each job. This is done with a double view in mind—first, to see that all work is done according to the specifications, so that no one is slighted or favored; second, to study the construction and life of different types of streets, thus making the association useful as an adviser to the city regarding any changes to be made in the present specifications.

The engineers representing the Association of Com-

merce have no legal authority to go on the street construction jobs and tell the contractor to make such changes as may be necessary in producing the best street under the given specifications. Nevertheless, they have become recognized in Chicago's street construction as influential factors. Everyone, from the Board of Local Improvements to the contractors, appreciates the fair, constructive and perfectly neutral attitude of the Association of Commerce in this activity. This phase of the association's work has gained such a prestige that it is able to save the public thousands of dollars each year, as well as being influential in helping to raise the quality of Chicago's street construction.

Face of Concrete Dam Imitates Stratified Sandstone

Strips of Muslin Laid Along Face of Work and Backed by Loose Sand or Clay Give Concrete the Special Finish Desired

THE NEW concrete arch bridge and dam completed at Deer Park, Ill., in the upper part of Deer Park Cañon near golf grounds, contains a special concrete finish for the face of the abutments and the lower side of the arched dam. A dam 30 ft. high was built at this site in 1901, and last summer it was decided to raise this 18 ft. higher by an arch about 8 ft. thick at the base and 2 ft. 6 in. thick at the top. In order to harmonize with the stratified sandstone rock which forms the walls of the cañon it was decided to form the face of the concrete into horizontal layers or ribs. This was accomplished by using muslin strips backed by loose sand and clay.

As a highway bridge was desired near the site of the dam, it was decided to combine the abutments for an

the water is forced out by gravity and sprays over quite a distance along the ledge.

HOW IMITATION ROCK WAS OBTAINED

The stratified appearance of the concrete surface was obtained by constructing the usual timber forms, allowing about 1 ft. extra width for the facing, and then using strips of muslin along the front face of the work



HIGHWAY ARCH APPEARS TO SPRING FROM STRATIFIED ROCK

with loose sand or clay placed between muslin and form, and about 1 ft. high. The muslin was then drawn tight, with its backing pushed into the desired form, and the concrete placed behind it, utilizing a relatively dry mixture and stiff mortar faces. By varying the thickness of the layers, a very fair imitation of stratified sandstone was obtained, the cloth giving the surface of the concrete the desired sandy appearance.

The plans for the bridge and dam were prepared by O. C. Simonds & Company, landscape gardeners, and the work was carried out under their supervision. The foregoing information was furnished by F. M. Button, a member of the firm.

Advocates Concrete Pile Bents for Economical Highway Bridges

After briefly reviewing the history of highway-bridge development, C. E. Nagel, deputy state engineer of the State Highway Commission of Minnesota, in the paper presented before the Northwestern Road Congress at Chicago, advocated the use of concrete pile bents combined with an economical type of reinforced-concrete superstructure. A concrete cap cast around the ends of the piles acts as a support for the spans, the economical length of which is about 20 ft. between bents of three piles each driven to a bearing of 20 tons. No abutments need be used, as the bridge should be made long enough to provide sufficient waterway after allowing for the 1:1 slope of a fill at each end protected by rip-rap. The Minnesota commission has designed a cellular slab bridge using curved corrugated-iron forms, which results in a saving of one-third in the volume of concrete. Trestle bridges can be built in multiples of standard span lengths, and metal forms and steel falsework would then be economical. In conclusion he says: "We believe that these bridges can be built with a saving of from 25 to 40 per cent under the cost of the present types and that they will prove far more satisfactory in the long run, and so are preparing plans for bridges of this type for next year's construction."



FACE OF ARCH DAM GIVEN SPECIAL FINISH TO IMITATE ROCK

arch bridge with those for the dam. The bridge, of 16-ft. roadway, is built on two arch ribs 24 in. square at the crown and 2 x 4 ft. in section at the abutments. These ribs have a radius of 40 ft., the span being 70 ft. for the downstream rib and 50 ft. for the upstream rib. The abutments are combined with those for the new arched dam, and are finished on the faces, as indicated by the photographs.

As the new part of the dam is to be used for reservoir purposes, bent pipe with valves are placed at about 5-ft. intervals so that water may be drawn off as high up the face of the dam as possible. These pipes connect with a molded ledge extending along the face of the dam

Effects of Exposure on Tar Products Reported by Federal Chemists

Usually Accepted Laboratory Tests Shown to Be Faulty as an Index of Permanence of Materials for Pavements

THAT changes occur in bituminous substances on exposure to the action of air and sun has been known for some time. These are not due merely to the volatilization of lighter oils, but molecular rearrangements, inter-reactions and oxidation play their parts. The work of extending this knowledge to the field of coal tars was undertaken by Charles S. Reeve, chemist, and Benjamin A. Anderton, assistant chemist, of the U. S. Office of Public Roads, who described their researches before the Franklin Institute in a paper, from which the following matter has been extracted.

Two refined coal tars, one refined water-gas tar, one refined mixed tar, two tar-asphalt mixtures, and one crude coke-oven tar were chosen and subjected not only to the usual laboratory tests but to exposure in a box designed to allow a dust-free circulation of air as well as the action of the sun's rays. The exposed samples were in quadruplicate, permitting a periodic examination of the tars during the three months' duration of the test. Besides the usual Engler distillation, the specific gravity, viscosity, bitumen soluble in carbon disulphide, free carbon, and the float-test time were determined, and the dimethyl-sulphate test run on the two tar-asphalt preparations.

Care was taken to insure a symmetrical disposition of the 28 samples with respect to the artificial-air circulation and access to the sun's rays. On the afternoon of April 21 the containing box was set on a shelf outside a window having an open southern exposure. As early as the following morning white flaky crystals of naphthaline had formed on the under side of the covering glass, the sublimation being greatest over the specimen of crude coke-oven tar. This disappeared as the temperature rose, but was succeeded later by an irregular deposit of a red, gum-like substance partly soluble in ethyl alcohol, but almost insoluble in carbon disulphide or benzol.

The average loss on a set of samples tested at the end of each month of exposure checks reasonably with the losses on the individual samples for the same period, indicating that the values obtained in testing the residues thus obtained are fairly comparable from month to month. All samples began to lose weight immediately on exposure, and these losses were progressive except in the case of the heavy refined coal tar, where the residue, after the second month, showed practically no change.

It is evident that the organic matter insoluble in carbon disulphide increased gradually. This may be seen from Table 1, in which this organic matter is referred to as "free carbon," although it may be partly composed of alteration products of tar distillates similar to the gum-like substance previously referred to.

It seems probable that there was an error in the determinations of free carbon at the end of the first month, but unfortunately sufficient material was not available for a check test.

From a calculation of the free carbon based on the loss of volatile matter, and a comparison of this with the figure representing the actual percentage, it is evident that the increase of free carbon is not due to volatilization alone. In every case the calculated percentage is shown to be less than the actual percentage and the greatest difference occurred in samples wholly or partly of water-gas tar.

To secure comparable data between the distillation

TABLE 1—TESTS ON SAMPLES SUBJECTED TO EXPOSURE								
Time of exposure in months	Refined coal tar 32° C	Refined mixed tar 50° C	Crude coke-oven tar Fluid	Refined coal tar 50° C	Tar-asphalt mixture 32° C 1'30" 50° C 42"	Water-gas tar preparation Fluid	Refined water-gas tar 50° C	
	1'5"	4'29"		2'16"			2'21"	
	Float test.....							
	Free carbon	19.36	17.13	8.77	29.65	14.57	2.47	0.72
1	Per cent loss, average of 4 specimens	10.17	2.27	17.68	7.26	10.76	19.32	3.25
	Per cent loss, specimen tested	10.32	2.39	17.92	7.34	10.76	19.71	3.27
	Float test at 100° C.....	24"	41.6"	30.3"	60"	34.1"	33.5"	28"
	Penetration, 25° C.....	190	47	82	16	116	111	89
	Free carbon	25.21	22.46	14.94	33.18	19.46	8.31	3.06
2	Per cent loss, average of 3 specimens	12.08	3.23	19.81	7.87	12.11	22.37	5.87
	Per cent loss, specimen tested	12.12	3.23	19.85	8.09	12.07	22.15	6.21
	Float test at 100° C.....	33"	44.8"	37.5"	78.5"	34"	38"	43"
	Penetration, 25° C.....	79	31	48	8	51	41	37
	Free carbon	23.56	20.06	15.15	32.51	18.73	9.27	4.69
3	Per cent loss, average of 2 specimens	13.47	3.87	21.32	8.08	13.01	24.24	6.97
	Per cent loss, specimen tested	13.39	3.77	21.21	7.85	12.84	24.18	6.67
	Float test at 100° C.....	41"	55"	47"	78"	48"	59"	49"
	Penetration, 25° C.....	50	28	18	11	47	19	20
	Free carbon	23.64	21.40	15.90	33.60	20.68	10.02	6.9

test and the results of exposure, samples of the original material were fractionated in accord with the methods in use in the U. S. Office of Public Roads. Besides the

TABLE 2—TESTS ON RESIDUES FROM EXPOSURE AND DISTILLATION					
Material	Residue	Per cent residue	Float test, 100° C.	Penetration, 25° C.	Per cent free carbon
Refined coal tar	Distillation to 315° C.	80.11	45"	32	25.21
	Distillation to 264.4° C.	85.80	34"	158	23.75
	Exposure 3 months...	86.61	41"	50	23.64
Refined mixed tar	Distillation to 315° C.	95.30	53"	24	19.69
	Distillation to 312.1° C.	95.18	49"	37	20.15
	Exposure 3 months...	96.23	55"	28	21.40
Crude coke-oven tar...	Distillation to 315° C.	80.96	27"	142	12.94
	Distillation to 343.6° C.	77.55	38.5"	41	12.93
	Exposure 3 months...	78.79	47"	18	15.90
Refined coal tar	Distillation to 315° C.	85.76	84"	5	35.50
	Distillation to 259.7° C.	91.18	68.5"	17	33.35
	Exposure 3 months...	92.15	78"	11	33.60
Tar - asphalt mixture	Distillation to 315° C.	77.93	114"	2	21.11
	Distillation to 259.7° C.	85.53	37.5"	55	19.30
	Exposure 3 months...	87.16	48"	47	20.68
Water-gas tar preparation..	Distillation to 315° C.	76.66	30"	107	3.80
	Distillation to 327.2° C.	74.34	43"	68	3.30
	Exposure 3 months...	75.82	59"	19	10.02
Refined water-gas tar.....	Distillation to 315° C.	95.95	29"	138	1.29
	Distillation to 329.6° C.	92.16	42"	66	2.36
	Exposure 3 months...	93.33	49"	20	6.09

end temperature of 315 deg. C., a separate distillation was terminated at the point which would leave a residue corresponding in amount to that resulting from exposure for three months.

It may be seen from Table 2 that, while distillation and exposure conditions were maintained as nearly uniform as was possible, there is a difference of 84 deg. C. between the maximum and minimum temperatures to which the tars were distilled in order to attain the same amount of residue as that left on exposure. With the exception of the coke-oven tar, those samples consisting in all or part of water-gas tar had to be distilled to relatively higher temperatures.

CONCLUSIONS

It is realized that the action of air and sun upon bituminous materials in their pure state, as carried on in this work, is probably very different from what it is when the material is in actual service, but the work as pursued would seem to point to the following conclusions:

1. Upon exposure to service conditions tar products materially harden to a much greater extent than can be attributed to loss of distillate alone.
2. The changes which take place, other than loss of distillate, are accompanied by formation of organic matter insoluble in carbon disulphide.
3. Tar products containing water-gas tar appear to change to a greater extent than coal tars, as indicated by the greater formation of organic matter insoluble in carbon disulphide.
4. The comparative consistency of pitches obtained from distillations of tars to a single arbitrary temperature does not represent the relative behavior of the tars in service.

Los Angeles Seeks Additional Water Rights for Aqueduct

The state water commission of California has received applications from the city of Los Angeles for right to appropriate 500 sec.-ft. of water from the Owens River system and 250 sec.-ft. from the south fork of Kern River to be used in supplying the city with light and power. Several hydroelectric plans are involved, according to the announcement of the commission. Of three plants to derive power from Owens River, one calls for a hydraulic fill dam 150 ft. high and 520 ft. long with a concrete core wall. This plant would take water principally from the Long Valley reservoir site. Low concrete dams are to be used for the other two Owens River plants. The heads on these three plants would be 1100 ft., 829 ft. and 384 ft. respectively, and the theoretical power involved would be 41,000, 34,000 and 15,000 hp. respectively. The fourth development, to be known as Kern River No. 2 power project, calls for a small diversion dam from which 13½ miles of conduit would convey the water in such way as to utilize a total fall of 2540 ft. and develop thereby a total of 45,000 theoretical horsepower. The Owens River filings are in accordance with plans already outlined, but the Kern River project is understood to be a new and separate proposition. Its waters are not tributary to the aqueduct.

Drive Small Cofferdams 40 Feet Deep in Six Hours Each

Piles Set Around Mast Carrying Hammer—Jets Excavate Foundation Wells for Buffalo Electric Plant in Two Hours

A LARGE number of small circular concrete and steel-sheet-pile piers were constructed through 40 ft. of mud and quicksand for the new power house of the Buffalo General Electric Company without ever pumping out the wells. The steel-sheet piling for wells in successive lines across the site was rapidly assembled, by two traveling cableways, around masts, each set on a pile in the center of each well, each mast carrying an upper template and also supporting the steam hammer for driving. Only six hours were required to drive the steel for each well and 2 hours on an average to excavate each with a jet pump. The concrete was placed under water with a tremie.

LARGE COLUMN LOADS CARRIED TO ROCK

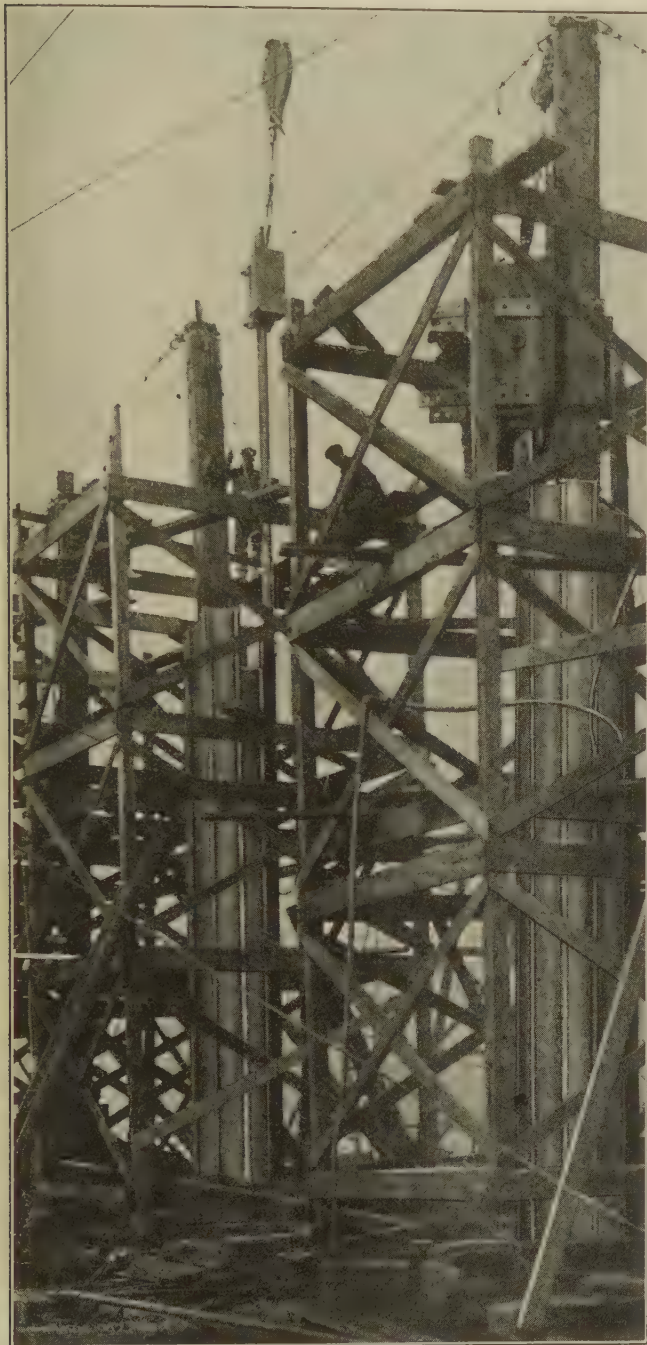
The power plant, which will have a capacity of 100,000 kw.—one of the largest steam plants in existence—is located near Buffalo and close to the Niagara River, in order to secure the large quantity of condensing water required. At the site selected on the river, however, the rock was 40 ft. below ground level and overlaid successively by 3 ft. of clay and boulders, 28 ft. of quicksand and 9 ft. of soft mud. The steam-generating plant to be supported on 157 footings represents a load exceeding 50,000 tons, and many individual columns must carry more than 850 tons apiece. The piers constructed to carry the building consist of reinforced-concrete shafts placed inside circular wells of 12-in. Lackawanna steel-sheet piling driven to rock. These piers vary from 40 to 81 in. in diameter. For the smaller wells, the web of each piece of sheeting was curved at the mill, but for the larger ones this was unnecessary.

CENTER PILE DRIVEN TO CARRY TEMPLATE

The piling was handled and assembled by two traveling cableways, each clearing the ground by 70 ft. This made it possible to thread the piles, which were 33 ft. in length, before any driving was started. To make these wells vertical and of full section all the way to rock, a large timber pile was driven at the center of each, to which a template of exact size was rigidly secured at ground level. In addition, the top of the pile was bored at the exact center of the well for a 3-in. pin on which a mast could be mounted to support an upper template. An 8-in. diameter iron band was placed around the head of each pile to prevent splitting. The masts, twelve of which were used to allow the sheeting to be assembled fast enough to keep five hammers busy driving, were of 14 x 14-in. timber, 42 ft. long. They were free to revolve about the 3-in. pin in the bottom and were secured by four guys each at the top. The upper template was fastened to each about 17 ft. above the lower one.

The hammers were handled from well to well by the cableways, but were supported in driving by steel cages fitting around the masts, the whole arrangement being raised and lowered by a set of falls to the top of the

mast, the lead line of which ran to a hoist on the ground. As the mast was free to revolve, the hammer could be carried around the entire circle, driving two piles together a few feet at a time until rock was reached. As the piling was to remain permanently in place, it was driven hard against the rock to prevent material coming in from the outside and interfering with the work of cleaning the bottoms. The steel-sheet



SEPARATE EQUIPMENT FOR SETTING AND DRIVING INCREASES SPEED OF CONSTRUCTION

piling for the 157 wells, amounting in all to 1300 tons, was entirely set and driven between Jan. 15, 1916, and April 6 following, only 70 working days being required in spite of an extremely severe winter.

The jet pumps used each consisted of 6-in. pipe about 40 ft. in length, inside which two 1½-in. water jets were installed. There was a valve at the top of the large pipe which was shut before the pump was set in

a well and kept closed until the small jets had carried the pump practically down to the clay. The large valve would then be opened and the pump allowed to run for about two hours, when all soft material would generally be removed from the well. These jets were supplied through an 8-in. main and 6-in. distributing pipes with water at 125 lb. pressure. The pumping plant consisted of a 1500-gal. multi-stage centrifugal pump. An extra jet was used to wash down material sticking to the sheet piling inside the wells.

The hard clay and boulders overlying the rock were broken up by raising and dropping a 35-ft. 13-in. sheet pile, after which this material could be removed with a small orangepeel bucket. The sand pump would then be replaced to clean up the bottom. In this work, two independent jets were used, one with a vertical and the other with a horizontal nozzle. The bottom of each well was carefully sounded all over with a long pipe rod to make sure that all clay had been scoured off. The method is stated to have been very successful in cleaning out all pockets and corners between the sheeting and the rock.

CONCRETE MIXER MOUNTED ON CAR

Railroad tracks were laid through a number of the lanes between lines of casings, so that the concrete could be placed upon a mixing plant located on a flat car. This was supplied with material by a locomotive crane. The reinforcing for each pier was made up in a unit and lowered into place before concreting was begun. The concrete was spouted from the mixer to the funnel of an ordinary tremie, which was raised and shortened by removing sections as the concrete came up. The bottom of the tremie was kept about 2 ft. below the top of the concrete and the pipe was kept full at all times. Concrete was carried to an elevation about 2 ft. below the top of the steel sheeting and allowed to set for two or three days, after which the water was pumped off and a concrete cap placed to carry the column footing.

The work is being carried on for the Buffalo General Electric Company by the Stone & Webster Engineering Corporation, for which S. L. Shuffleton is in charge as superintendent.

Give Costs of Blasting Drainage Ditches

Costs of blasting drainage ditches on the Montana Agricultural College Experiment Station farm are less than that of hand-dug ditches. Circular 55 of the station states that the ditching was done in soil very gravelly and full of large stones, making digging difficult and expensive. Two sticks of 60-per cent Hercules dynamite were placed in holes 22 in. apart, this distance being determined by experiments to be the most desirable for the soil conditions. About twenty-five holes were usually fired at one shot, the middle hole being used for the primer. A length of 647 ft. was blasted at a cost for labor of \$1.31 per rod. The expense of cleaning the ditch after blasting was 27 cents per rod, which is included in the foregoing cost. Dynamite, caps and fuse for the job cost \$1.05 per rod (dynamite at 22 cents per pound). In 1915 14 rods were dug by hand for \$3.35 per rod, 17 yd. blasted for \$3.10 and 39.2 yd. for \$2.36 per yard.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Unit Stresses for Pipe

SIR: Referring to the article by Barton M. Jones, entitled "Higher Unit Stresses for Pipe and Computation of Water-Hammer Pressure Advocated," printed in your issue of Dec. 30, 1916, page 794, several good points have been brought out by Mr. Jones with regard to the distribution of water-hammer pressure along a pipe and also the need of its computation in design. But on the other hand Mr. Jones' arguments for higher unit stresses hardly seem logical when compared with standard practice in the design of other structures. The term "safety factor" appears to have been misinterpreted.

In all standard specifications on structures the severest loading is required to be used in figuring stresses, and on top of this a safety factor of four, at least, is allowed in the unit stresses for the material in question. Now, in the case of a steel penstock for a hydroelectric development the uncertainties as regards maximum stresses are probably of the greatest. It is not therefore justifiable in this case to cut down the safety factor by the use of high unit stresses, as Mr. Jones proposes, or to use the chance of maximum water hammer as a portion of the safety factor, when in reality it is a danger factor.

In the first part of his article Mr. Jones points out that water-hammer pressures can readily be calculated for any assumed conditions of gate closure, and then later in his article he proposes an inconsistent method for high-head penstocks by the use of the pressure rise due to sudden gate closure for all cases, regardless of the time of gate closure.

This would give results that would be anything but consistent, for in the case of time of gate closure being less than the critical time—that is, the time required for the pressure wave to travel to the forebay and back—the pipe would be stressed to the elastic limit, resulting in a safety factor of two on the ultimate stress. Now on the other hand take the case of time of gate closure greater than the critical time. Your safety factor might be raised to three or four, according to the length of time of gate closure.

In the writer's opinion the only way to get consistent, and yet economical, results is to figure static stress plus water-hammer stress and use a unit stress that gives the required safety factor.

Another point that has been overlooked by Mr. Jones in his argument for higher unit stresses is the fact that a riveted steel pipe when stressed to its elastic limit changes its shape an appreciable amount due to the elastic properties of the metal.

This stretching of the metal if carried to the elastic limit by water-hammer pressure and then allowed to return to its normal size under static conditions will invariably result in a leaky pipe. This is due to the fact that the joint does not act as a unit with the pipe with the result that the calking and riveting of the

longitudinal joints seldom return to their original condition if subjected to any considerable distortion brought about by excessive stresses in the metal.

The statement that "It will be noted that the length of the water column does not affect the calculations except as to what would be termed 'sudden closing,'" is incorrect unless you change "sudden closing" to "gradual closing." Mr. Jones has not made very clear the difference between sudden gate closure and gradual gate closure. For sudden gate closure the time of gate must be less than the critical time—that is, the time required for the pressure wave to travel from the gate to the forebay or reservoir and back—and for gradual gate closure the time of gate must be greater than the critical time.

The method Mr. Jones gives for treating gradual gate closure, while giving accurate results, is long and laborious. Allievis' formula,

$$h = \frac{NH}{2} + H \sqrt{\frac{N^2}{4} + N}$$

where h is excess head in feet, due to water hammer; H , normal static head in feet; N , $(LV/gTH)^2$; L , length of pipe in feet; V , velocity change of water in pipe in feet per second; T , time of gate closure; and g is 32.2 will give accurate results for slow gate closure with much less time and labor.

R. L. HEARN,

Hydroelectric Power Commission of Ontario.

Toronto.

[A copy of the foregoing letter was submitted to Mr. Jones, whose reply follows.]

SIR: The title printed over the article mentioned was somewhat misleading, as the article does not advocate unit stresses higher than are now used on important structures. The practice against which I took issue is the common use of a low unit stress in connection with the static pressure in determining the pipe thickness. as the procedure gives an unbalanced distribution of material. It was proposed that the pipe be so proportioned that at the verge of danger (which may be assumed to be at any particular stress, such as the elastic limit of the material) the stresses will be evenly distributed over all parts of the pipe.

There should be no known relatively weak points at such a time. In this method of design the stress in a pipe is not intended to reach or exceed the elastic limit of the material. However, if by accident it should, a leaky pipe as the result would certainly be preferred to a ruptured one.

With reasonable assumptions, the method outlined by me would give a safety factor of about four. The "severe" water-hammer pressure mentioned, while not specifically so stated, means about twice the estimated maximum water-hammer pressure that would occur, the exact ratio depending on the judgment of the engineer in considering his particular case. If by accident this pressure should occur, the stress in the steel would be

raised to the elastic limit (if such were the figure used in the design), but the pressure could again be doubled before passing the ultimate strength. That is, in this case the estimated maximum stress would be about one-fourth the ultimate. The term "safety factor" is generally accepted as being a measure of the margin between the estimated maximum stress likely to occur and the ultimate breaking stress of the material.

It is true, as Mr. Hearn states, that a steel penstock of a hydroelectric development is subject to the greatest uncertainties as regards maximum stresses. The problem then is to provide for as great shock as possible at a cost within reason. The chance of the stresses becoming double those estimated is about equal to the chance of a defect reducing the strength of a pipe to one-half its estimated ultimate strength. It therefore seems reasonable to divide the margin of safety about equally into an allowance for accidental pressures and for defective pipe; in other words, to cause the allowance for safety factor to act as effectively as possible if it should come into service. This is the main idea of my article.

Evidently a misunderstanding caused Mr. Hearn's second objection, as it was not proposed to design all high-head penstocks for a pressure rise due to sudden gate closure. An illustration was cited where it might be done if desired at less cost than by another method. Gradual closure will produce the same rise in pressure as will a sudden closure of a flow equal to that which is gradually closed off during an interval equal to the critical time. In this manner the sudden closure of partial flow may be used in computing excess head for gradual closure.

It is immaterial whether the term "sudden closing" or "gradual closing" is used in the connection pointed out by Mr. Hearn. The length of the water column determines the critical time, and thereby gives data to distinguish between sudden and gradual closures. A gate closure completed in less than the critical time would have the effect upon pressure rise of sudden closing, while if the time were greater the effect would be that of gradual closure.

As regards the relative time and labor involved in computing simply excess pressure under like conditions, it will be shown that the Allievis formula is by far the more cumbersome to use. Upon the assumption, which seems correct, that the ratio of water-hammer pressure for slow closure to sudden closure is as the critical time is to the actual time of closure, the formulas in my article for excess head (sudden closing) and for the critical time T may be used to give the initial or highest pressure due to water hammer for any time of gate closure equal to or greater than the critical time.

Unless affected by extraordinary conditions, such as the irregular action of a governor, the pressure rise cannot exceed its value as computed for the critical time. For the unusual case assumed in the Allievis formula, where the entire length of the pipe is of constant diameter and thickness, the equations will combine and reduce to $h = 11.40Ql/\bar{d}t$, which is equivalent to the usual form $h = 2lv/gt$, in which h is the excess head produced when the flow Q in second-feet, or the velocity V in feet per second, is extinguished at a uniform rate in t , seconds; l is length of pipe in feet; g is 32.2, and $\bar{d}$ is the inside diameter of the pipe in inches

the notation being different from that used in the article. Neither of these forms, nor the Allievis formula, is applicable when the time of closure, t , is less than the critical time.

It is claimed by some that for slow gate closure the Allievis formula will give more accurate results for water-hammer pressure than those given in my article and upon this basis its use would of course be justified. Under some conditions it will give only half as great pressures as those above, and the results are said to agree well with experimental observations.

In cases of slow closure the pressure at any particular point will commence and continue to rise as the valve closes, until it is affected by the first returning pressure wave. This first pressure rise is not affected by disturbing influences, and its maximum value is subject to reliable calculation. The subsequent pressure waves are so affected by interference that they are far less severe than the initial wave, and unless the pressure of this initial wave is measured, the observed pressures may be misleading, as they will not indicate the maximum that has been reached. The results would lead to the acceptance of the Allievis formula or another, $h = lv/gt$, which is used by some.

It is the initial or highest pressure, the duration of which is too long for its effects to be overlooked, that must be provided for in the design of the pipe. This is the pressure which is considered in my article, and is obtainable from the equations given therein.

Note that a correction in the formula for the velocity of the pressure wave was given in the Engineering Record of Jan. 13, page 57.

BARTON M. JONES,

Division Engineer, Miami Conservancy District.
Dayton, Ohio.

Concrete Institute vs. Joint Committee

SIR: From the account of the convention of the American Concrete Institute, published in your issue of Feb. 17, page 279, it might not be clear just what was done by the Concrete Institute in disposing of the report of the Joint Committee.

The committee for the Concrete Institute on reinforced concrete and building laws made its report to the association, which report was received and ordered to letter ballot. Later the Joint Committee report was brought before the convention and was received and ordered printed. In other words, the American Concrete Institute took the same action on the Joint Committee report as did the American Society of Civil Engineers, and the same action as has been recommended by the masonry committee of the A. R. E. A.

Inasmuch as many felt that the question of discrepancies in the standards, as between the report of the Joint Committee and the committee of the Concrete Institute, should be examined into, later action was taken postponing the letter ballot on the report of the committee of the Concrete Institute for a period of one year. This disposition of the matter seems to the writer to be entirely fair and proper. Whether or not the coefficients of design adopted by the Joint Committee or those recommended by the American Concrete Institute committee represent the more conservative and economical use of materials is a question to be decided upon evi-

dence, derived from several sources—for instance, the logic of mechanics, experience in properly reported service, and experimental investigation.

The writer's view is that both the Joint Committee and the committee of the Concrete Institute used their best judgment in default of clear evidence. It is not known for certain at present which committee report has the greater weight of evidence back of it.

W. K. HATT,

President, American Concrete Institute.
Lafayette, Ind.

Surge-Tank Problems

SIR: Referring to the article by A. G. Hillberg in your issue of Dec. 23, 1916, page 763, Mr. Hillberg has made certain statements which, if allowed to go uncorrected, leave a very misleading impression on the reader.

The title "Surge-Tank Problems Solved by New Methods" is inaccurate, since no solution of the problem is given. What Mr. Hillberg suggests is an arithmetical integration of the surges in a simple tank under change of load. Such arithmetical methods of checking a given design have been made many times to the writer's knowledge. In fact, certain of the recent textbooks on hydraulics illustrate the method.

To illustrate one of the inaccuracies of the article, Mr. Hillberg makes the statement that the effect of friction on the surges in a conduit connected to a standpipe is to diminish the oscillations. "Consequently," he continues, "if no additional change in load occurs, the water level will fluctuate with smaller and smaller oscillations until finally the new level has been attained. To one who has done any work with the simple tank this statement at its face value, without a reference to the effect of governor action, is absurd.

Whether these oscillations for a given load change will diminish is entirely a question of size of tank used on the particular problem studied. As a matter of fact, if the area of the tank is below a certain critical amount and the swelling effect due to the governor action exceeds the damping effect due to the action of friction, the oscillations will increase.

The process of checking any given design by computing the various curves of change of water level in tank, velocity, etc., by the use of small increments of time is so obviously simple that it is strange that it has not been used to a greater extent. The analysis given by Mr. Hillberg is not necessary, since only the fundamental physical laws are used, and such approximations as are introduced by him are not required. He states that higher mathematics is not required in solving these problems and then closes his paper with the suggestions that formulas developed by R. D. Johnson and L. F. Harza be used for fixing the size and obtaining the time of swing of surge. It is rather interesting to note that these formulas have been developed by the use of calculus.

Aside from the accuracy of Mr. Hillberg's analysis, which can be seriously questioned, it appears to the writer that this paper represents a great deal of wasted energy. A far better and safer solution of the troubles incidental to the use of long conduit lines on power-development work is obtained with the differential surge tank developed by R. D. Johnson. This tank offers so

many advantages over the simple tank that no excuse appears to exist for the continued use of the latter.

T. H. HOGG,

Assistant Hydraulic Engineer, Hydroelectric Power Commission of Ontario.
Toronto.

[As is customary, a copy of this letter was submitted to Mr. Hillberg, and his reply follows.]

SIR: Mr. Hogg was for several years connected with the editorial department of the *Canadian Engineer*, and therefore ought to know that the headlines of articles are not, as a rule, written by the authors. The duty of a headline writer is to catch the reader's interest and to make him read the articles. Mr. Hogg has undoubtedly many times, in the past, not only given articles new headlines, but, also, rewritten the first paragraph in order to, so to say, "lead the reader on." When my article was submitted it was modestly headed "Surge-Tank Problems," so that it is not fair to hold me responsible for the headline as printed.

Mr. Hogg's statement that the method outlined has been published in recent textbooks is a surprise, as the writer is unaware of it.

The statement that the friction tends to diminish the surges is correct, but the question of governor action was not considered for several reasons in the article in question. First, the wheels used under relatively high heads are Francis turbines of low specific speed, or impulse wheels. For the latter type the drop in efficiency is very small and its influence on the flow in the penstock negligible, especially when a deflecting nozzle is employed.

For Francis turbines of low specific speed the drop in efficiency for gate openings over 0.8 is less than that for wheels of high specific speed, so that the "fanning" influence of the governor is less in the former case than in the latter.

As a power plant always has more than one unit, and as load charges will be distributed on all the units operating at the time, the change in their efficiency will be very small, so small that the "fanning" action of the governor can be neglected. Furthermore, it is seldom that a surge tank is designed for a change in load of more than 25 per cent, as greater variations are unlikely to occur except in extreme emergencies.

However, Mr. Hogg is correct in stating that if the area of the tank is too small, the action of the governor might become serious under certain extreme conditions. If, in the method described in my article, it is desired to take into account the fluctuations in efficiency of the wheels at different gate openings, this can easily be done by figuring the discharge required under the average head prevailing during a given interval of time and increasing or decreasing the penstock velocity a corresponding amount.

The writer suggested the use for preliminary investigations of the formulas developed by Strickler, Johnson and Harza not because it is necessary to use them but because of the convenience and saving in time.

Mr. Hogg concludes his letter by advising engineers to drop the use of the single tank and adopt the Johnson differential tank. The writer agrees with Mr. Hogg that the differential surge tank is admirably adapted for damping surges effectively, but unfortunately it cannot

always be applied. A few months ago the writer designed a development where the conduit was about 30,000 ft. long and the gross head 345 ft. The losses in the long conduit amounted to about 50 ft., and in addition the fluctuation in level of the storage reservoirs was 90 ft.

To build a differential surge tank to meet these requirements would have been difficult, and finally a surge tank to be blasted out of the rock was proposed. This tank will be provided with large chambers at its upper and lower ends connected by a shaft of 10 x 10-ft. cross-section.

Mr. Hogg is located in Canada, where there are no patents on the Johnson tank, and where everybody who feels so inclined can design and build as many as he likes. In the United States, however, the patents on this tank are very strong, and, consequently, the additional cost of the royalty has to be considered.

A. G. HILLBERG,
Hydraulic Engineer.

New York City.

How to Melt Lead from Joints of Water Line

SIR: In your issue of Dec. 23, 1916, page 779, Harry Watts asks regarding melting lead from the joints of a 24-in. cast-iron water line.

The writer has had occasion to remove a considerable amount of cast-iron pipe with lead joints, and has also experimented with a gasoline blow torch and other devices for using a local flame to heat the lead, all of which he found absolutely ineffective. In removing a 48-in. line and several smaller lines the only really satisfactory method found was to excavate a bell hole beneath the joint and build in it a wood fire. This is probably the cheapest and best method that could be used.

However, the acetylene torch had not been developed at the time this work was done. Recent work done with the torch would lead the writer to believe that it could be successfully used. There is serious doubt in his mind, however, as to whether the wood fire would not, after all, be very much quicker and cheaper.

J. H. WEATHERFORD,
City Engineer.

Memphis, Tenn.

SIR: Referring to the inquiry of Mr. Watts relative to taking up cast-iron water mains, during the past season the writer had a contract for water-main extensions which included the taking up of 500 ft. of 8-in. and 2000 ft. of 4-in. cast-iron pipe. The oxyacetylene flame was used to melt the lead out of the joints. For experiment a gasoline and also a kerosene flame were tried, but were too slow.

The pipe was uncovered and a small bell hole dug at the joint to be melted. (Eight-inch pipe were taken out two lengths and 4-in. pipe three lengths at a time.) This bell hole was just large enough to permit the torch to play around the entire joint. A small derrick was placed over the open end of the pipe, and the line to the derrick hooked to the bell or open end of the pipe. The pipe was raised several feet and blocked. The derrick was then moved to the center of the pipe and the line to the derrick fastened around the pipe and the blocking removed. While the pipe was thus swinging it was unjointed by pulling with a long bar. This

bar was set alongside the pipe and fastened to it with a chain in such a manner that when pushed forward a slight turn was given to the pipe, which helped to unjoint. A small hole in the ditch served as the "bait" for the bar. Two men worked the bar.

When all the lead was removed from the joint the unjointing of the pipe was easy, but if only a very small piece was left, it was necessary to drive it back with a yarning iron before the bead on the end of the pipe would pass through the bell. The jute also would jam around the bead and cause trouble.

When the joint was hot it came apart much easier than when cold, especially if a small piece of lead was left. This piece of lead seemed to be more pliable and would flatten out enough to allow unjointing, and the jute as soon as exposed to the air would start to burn.

HENRY OLK,
Antigo, Wis. Engineering Contractor.

SIR: In regard to suggesting a good method of melting the lead from the joints of a water line, we have had occasion to take up mains and find the following method to work out to good advantage:

After getting the pipe uncovered we take a pipe cutter and cut off the pipe ahead of the bell so that we can raise three or four lengths of pipe out at once and melt the lead out of the two or three joints, depending on the lengths taken out at a time. When the pipe is laid on top of the ground, this may be done by a fire, blow torch or carbide outfit.

Unless you start from a dead end it will be necessary to make two cuts to get the first section out. After that only one cut is necessary. On every joint cut you will lose a small section of the pipe, but the loss is overcome by being able to melt the lead on top of the ground instead of working in the ditch, and by being able to raise three or four lengths out of the ditch at one time.

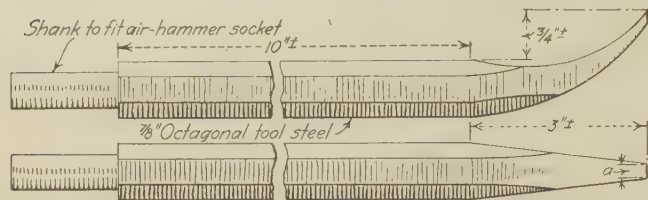
W. H. STEINER,
Marshalltown, Iowa. City Engineer.

SIR: The writer had to take up about 1200 ft. of 30-in. cast-iron gaspipe with yarn and lead joints. Oxyacetylene apparatus was tried, but one of our assistant general foremen, who was in direct charge of the work, under the writer, believed that the progress was not sufficiently fast and that better results could be obtained by using a pick-out tool in conjunction with a gas-driven air compressor.

This man designed a pick-out tool like that shown in the accompanying sketch, and the results were exceedingly satisfactory. It was found that almost twice as much speed was obtained with this tool as with the oxyacetylene apparatus.

The reason for this difference the writer believes to be as follows: On pipe sizes from about 16 in. up, the slope of the sides of the pipe is not sufficiently steep to permit the rapid flowing to the ground beneath of the melted lead from the joints, hence this melted lead, which cools rather quickly, piles up in a lump on either side of the melting torch, and has to be burned away piecemeal. Even though the burning out of the joint is begun at the extremities of the horizontal diameter,

this condition holds good at a short distance above and below either extremity of that diameter. The difficulties increase as the torch is entered deeper into the bell of the pipe. With the pick-out tool, however, it was possible to enter the tool easily to a depth of from $\frac{1}{4}$ to $\frac{1}{2}$ in. and follow around the circumference of the



PICK-OUT TOOL TO BE DRIVEN BY AIR COMPRESSOR

The dimension *a* should be about two-thirds the width of the joint in the bell, or the distance between top of spigot piece and inner periphery of hub.

joint for quite an arc length, poking the lead out and away in a long thick ribbon, much as a carpenter would make a cut in a soft pine board with a chisel, using a hammer in place of the air pressure.

R. C. KELLOGG,

Brooklyn, N. Y.

Civil Engineer.

Filtration, the First Line of Defense

SIR: Your editorial of March 10, page 370, dealing with the water-purification problem of the city of Milwaukee and the recommendation of the United States Public Health Service to construct a water-filtration works, is to be commended. I believe, however, that it would have been more equitable to mention the results that have been accomplished by the application of liquid chlorine to that supply than to speak of the results that have not been accomplished. I cannot agree with you that chlorine in quantities below the complaint point will not make a water safe. It is entirely a matter of distribution. If to each unit of water is distributed its proportionate amount of liquid chlorine, satisfactory bacteriological results will be obtained, and very seldom at the expense of the physical characteristics of the water.

We agree whole-heartedly with you that the filtration of any heavily polluted water supply is desirable. We have maintained, and have so indicated in all our literature, that chlorination is not a substitute for filtration; for although chlorine will render any water supply safe to drink, it will have very little effect on turbidity or color, and although chlorination should be used as a safeguard for every water supply, irrespective of its source, it should very frequently be used to supplement filtration.

The value of liquid chlorine in the field of water purification needs no exposition here. The number of lives that have been saved, the water supplies that have been made safe for domestic use and the marked decrease of the typhoid-fever rate in practically every case where chlorine has been adopted are sufficient testimonials of the value of the process. Complaints of unsatisfactory treatment and of tastes and odors when liquid chlorine is used are fundamentally due to improper and uneven distribution of the chlorine in the water to be treated.

WILLIAM J. ORCHARD,

Sanitary Engineer, Wallace & Tiernan Company.

New York.

SIR: While I heartily agree with most of the statements made in your editorial of March 10, entitled "Filtration, the First Line of Defense," still to others it may be somewhat misleading. It happens that I was instrumental in having installed at Milwaukee a chlorine plant which, it seems, has not, with entire success, been able to cope with the situation prevailing there, and I am sure that no one will welcome more sincerely than I the filtration which is recommended and doubtless much needed.

Milwaukee's water supply is a most difficult one for chlorination to safeguard unaided, apparently because of a high organic content and the unusual chemical characteristics of the water which tend to neutralize the sterilizing agent and diminish the efficiency of its action upon disease-producing bacteria. Although I have installed chlorination plants in hundreds of cities and towns in the past few years, I cannot recall another city which presents greater difficulty for chlorination used without any other measure of purification. However, I believe that your editorial tends to ignore, or at least minimize, the results accomplished with chlorine in the face of these difficulties.

Chlorination at Milwaukee by hydrochlorite of lime began in 1910—an epidemic year—and was followed by the application of liquid chlorine in 1914. I regret that I have not the typhoid mortality rate during 1916, but during the first five years of sterilization the results with the chlorination process were as follows:

Year	Typhoid deaths per 100,000
1910.....	45
1911.....	27
1912.....	26
1913.....	11
1914.....	8
1915.....	4½

Were this merely an isolated case of consistent mortality reduction, due to chlorine, then I would have no occasion to comment upon your editorial; but the results actually accomplished in numerous cities certainly lift chlorination out of the category of "emergency and factor-of-safety" measures. Just offhand I can name several towns whose typhoid death rate has become zero with the introduction of liquid chlorine treatment—for instance, Alpena, Mich.; St. Catharines, Ont.; Logansport, Ind., and Ossining, N. Y. Typhoid deaths have been unknown in these four towns since chlorination, over a period averaging more than two years. The combined population of these towns is 60,000, and previous to chlorination they had a combined typhoid mortality rate of 46 per 100,000. Would you call this "emergency" accomplishment?

I will not tire you with further statistics, but will merely remind you that a substantial and progressive decline in typhoid mortality has invariably followed the introduction of chlorination even when the sole protection is this "emergency measure"! (See records of Sacramento, Buffalo, Utica, N. Y., Tacoma, Wash., and Wilmington, N. C.) And when filtration is in operation previous to chlorination, and records over a sufficient period for accurate determination of the mortality rate are available, there is, as a direct result of this subsequent chlorination, a consistent, and I might safely say an invariable, decline in typhoid mortality

below its previous minimum, with a uniform tendency to continued decline. (See records of Kansas City, Denver, Philadelphia, Wilmington, Del., St. Louis, and Paterson, N. J.)

I do not want you to set this letter down as a bit of special pleading, for I have not the slightest desire to minimize in any way the importance of filtration as "permanent construction." I would consider myself most unworthy if I should neglect any opportunity to recommend filtration whenever a community can afford it—and few cannot when its value is realized.

But at the same time I am confident that a brief study of the records of the cities named, and others, may perhaps influence you in a future editorial to consider chlorination more nearly in its true relation to the problems of water supply—as an integral part of the permanent construction. JOHN A. KIENLE, Assoc. M. Am. Soc. C. E.; Sanitary Engineer, Electro Bleaching Company.
New York.

Another Test Discredited

SIR: As a member of the Committee of the American Society for Testing Materials on Distillation that put forth the present accepted distillation test on tar, I must emphatically protest against the publication of such pseudo science as is given in your editorial of March 10, page 369, entitled "Another Test Discredited."

Any such deductions as you have drawn from the paper by Messrs. Reeve and Anderton are entirely unwarranted by the facts. I am sure that no one would be more quick to say so than the gentlemen themselves. Their work proves beyond question the great value of the distillation test, and the mere fact that the tars of such varied origin do not group themselves in the same order by the distillation and by the weathering test was only to be expected. All work previously done on tars would point conclusively to the same results.

The distillation test is only one of a number of tests used in valuing tars. They cannot be used separately, but must be judged in their interrelation, one to the other. It would be just as logical to judge an asphalt by the penetration test alone, and to say, since a series of asphalts did not group themselves in the same way when their insoluble residues were determined, that therefore the penetration test was of no use.

What the Office of Public Roads thinks of the distillation test is perhaps best shown by the specifications issued by the Office of Public Roads. All tar specifications contain the distillation test. The form specification for approval by the state highway departments recently considered in Washington at a meeting of state highway engineers also gives the distillation method under tar specifications.

In fact, the distillation test, instead of being a discredited test, is very much of an accredited test, and I am surprised that the Engineering Record should be so led astray in a matter so easily verified.

PHILIP P. SHARPLES,
Manager, General Tarvia Department, The Barrett Co.
New York City.

[Copy of this letter was submitted to Charles S. Reeve, chemist, U. S. Office of Public Roads, whose reply follows.]

SIR: Your letter of March 16, with inclosures calling attention to an editorial and correspondence relating to a paper on "The Effects of Exposure on Tar Products," by B. A. Anderton and the writer, were duly received. We were at the same time in receipt of a letter from Philip P. Sharples, submitting a copy of his views as expressed to the editor of the Engineering Record. Appreciating the sincerity of all parties to the controversy, I believe that a statement on the part of the authors of the paper under discussion is in order, to make clear their position.

A careful review of the paper and editorial in question would indicate that the editor has made a broader interpretation of the idea which the authors attempted to convey than is warranted by the data and conclusions. The writer of the editorial in question is justified in his conclusion that the distillation test gives no data on tar products which can be directly correlated with the behavior of these same tar products under service conditions. The authors clearly indicated this in conclusions 1 and 4, which are as follows:

1. Upon exposure to service conditions tar products materially harden to a much greater extent than can be attributed to loss of distillate alone.

4. The comparative consistency of pitches obtained from distillation of tars to a single arbitrary temperature does not represent the relative behavior of the tars in service.

It will be noted that both clauses specifically refer to the relation between distillation results and service results, but the editorial would give the impression that the distillation test has been entirely discredited. In doing so it does clearly misinterpret the intent of the authors.

The authors do not feel that the data submitted by them have proved beyond question the great value of the distillation test, but this test will no doubt continue to be an essential one for aiding in the determination of the source, quality, and acceptability of tar products. The writer, with Mr. Sharples, as a member of a subcommittee on distillation of the American Society for Testing Materials, investigated and recommended the standard test now generally accepted, and will continue to indorse the inclusion of a distillation requirement in specifications. The distillates serve to assist in identifying the type of tar, and must necessarily be obtained if an effort is made to prove or disprove the addition of petroleum or asphalt products. The consistency of the pitch obtained from distillation, while it does not indicate the consistency to be expected from tars when exposed to service conditions, will assist in determining the quality and character of the product in so far as its method of preparation is concerned. It is for the latter reason that a melting-point requirement was included in the distillation clause of the form of specification recently recommended by the Conference of State Highway Testing Engineers and Chemists. The authors, as members of the conference, coincided in indorsing such a requirement.

The foregoing discussion should serve to make clear the conclusions of the authors, which indicate lack of direct relation between distillation values and service results, without any intention of discrediting the use of the distillation test as a specification requirement when its purpose and value are correctly understood.

Owing to the fact that the authors are daily in receipt of letters calling their attention to this editorial and asking an expression of their views regarding it, they trust that the above discussion may be given sufficient prominence to make clear their position in the matter.

CHARLES S. REEVE,

Chemist, Office of Public Roads and Rural Engineering.

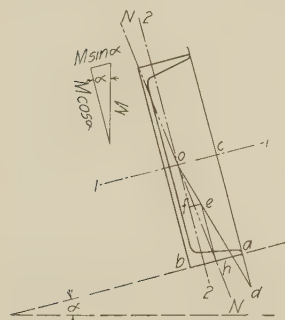
Washington, D. C.

[The Engineering Record desires merely to point out that identification tests, such as the distillation test undoubtedly is, have their value, but should be placed in a separate category from definitive tests. They are, after all, only an explanation, in technical terms, of the title of the specification, and should in no sense be considered as a measure of use-value. Reference to the editorial in question should suffice to demonstrate that the attack was made upon the distillation test as a measure of the ability of a tar to resist changes following upon exposure. With this position Mr. Reeve seems to be in agreement. It is unfortunate that writers of specifications do not always differentiate more clearly between those tests which are only intended to identify a material and those which are expected to measure its value.—EDITOR.]

Locating Neutral Axis of Roof Purlins

SIR: In connection with Mr. Fleming's article in the Engineering Record of March 3, page 347, on the design of steel purlins, I inclose a graphical method for locating the neutral axis when the plane of the bending moment is not parallel to a principal axis of the purlin.

Assume a 10-in. 15-lb. channel purlin on a roof with 15-deg. pitch. The compression at the point a due to the moment $M \sin \alpha$ is found to be $0.221M$, and the tension due to the moment $M \cos \alpha$ is $0.072M$. On the line ca lay off $cd = 0.221$ to any convenient scale and draw od . On the axis 2-2 lay off 0.072 to the same scale. Draw fe parallel to the axis 1-1, and eh parallel to 2-2. Then the line NN through h and o is the neutral axis.



to 2-2. Then the line NN through h and o is the neutral axis.

The correctness of this method is easily proved. As all points on the line ca are subjected to a compression of $0.221M$ due to $M \sin \alpha$, and the stress varies as a straight line, all points on the line eh parallel to 2-2 are subjected to a compression of $0.072M$ (by similar triangles), and this equals the tension along the line ab due to $M \cos \alpha$. Therefore at the intersection of eh and ab there will be no stress, and this point lies on the neutral axis.

The writer made use of this method several years ago in some similar work, and it may be of interest to your readers.

LEROY W. CLARK,

Assistant Professor of Mechanics, Rensselaer Polytechnic Institute.

Troy, N. Y.

[It is evident that the point h could be located by computing the ratio $0.072/0.222$ times the distance from

a to axis 2-2; furthermore, it is a question whether the simple formula for angle θ given by Mr. Fleming would not be sufficient and save time. A complete graphical method for locating this neutral axis is given in the Hütte handbook, page 387 of the 1905 edition and page 530 of the 1915 edition.—EDITOR.]

Fills Under Concrete Roads Should Be Seasoned

SIR: I have read with interest the good points in concrete road building being brought out in your recent issues, and I wish to call attention to one subject I have not seen discussed, but which is of vital importance on this work.

Most specifications provide for rolling in thin layers of all deep fills, but even when conscientiously done the fresh fill is not fully settled when the work is completed and accepted. The final shrinkage of the filled material was not noticeable on macadam roads, but the large and plentiful cracks to be found in almost all concrete slabs over deep fills indicate a "haste that wastes." I believe that, after all the customary precautions to obtain dense fills have been taken, the roadway should be opened to traffic and seasoned for a winter before laying concrete. Where such fills constitute only a small part of the work, the slabs may be omitted over deep fills and enough broken stone spread to provide a passable road until spring, when the remainder of the pavement may be poured. This stone, when spiked and rolled, provides an ideal foundation for the concrete pavement where such reinforcement is most needed.

This seasoning of fills may not be as convenient as rushing the work to completion in one season, but will remove all the weak points in the present practice of concrete road construction, and make for better roads and real economy.

E. EARL GLASS,

Los Angeles County Road Department.

Monrovia, Cal.

A New Attitude Toward Road Building

Instead of constructing annually a few miles of disconnected hard surfaced road, Ogle County, Illinois, expects to indulge in a wholesale road-grading program, the cost of which will be reduced to a minimum by letting the work in large contracts. The size of the work undertaken will justify the contractor in providing an ample plant and hiring the most competent labor—a thing which is rarely possible in small undertakings. At the same time, permanent bridges and culverts will be constructed. This plan is recommended because it is found that the present method of permanent though disconnected improvement was unpopular, since it did not result in enough general benefit. On the other hand, the proposed system is warmly approved, particularly as it relieves the township of the necessity of caring for the unimproved roads over which perhaps 75 per cent of the travel passes. The plan gives the county a complete system of well-constructed roadbeds with seasoned embankments ready for a hard surface whenever the volume of travel warrants it and the funds are available. The cost is to be met by issuing short-term bonds, and the total necessary will not strain the county's financial resources.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Oval Gravity-Return Track Used to Feed Aggregate to Mixer

By W. R. HOWARD

Assistant Superintendent, Ferro-Concrete Construction Company, Cincinnati, Ohio

A SHORT inclined track elevator set on one side of the mixing plant in an oval track on which aggregates were delivered in small cars was used with great success by the Ferro-Concrete Construction Company in building the new five-story plant of the American Tool Works at Cincinnati, Ohio. On account of the size of the building, the lot being 250 by 260 ft., and the location on the railroad siding, as shown in the photograph, it was desirable to place the concrete mixer and tower in the center of the lot at some distance from the unloading point and storage bins.

In order to supply the mixer with materials and still avoid using a greater number of laborers, the oval gravity track shown in the photograph was laid out. This 2-ft. gage track was arranged so that a car on leaving the mixing platform ran by gravity to the material bins, where it was checked by two men who filled

it with stone and sand, and then released and allowed to run by gravity to the foot of the incline on the opposite side of the mixing plant from which it had started. Here it was elevated again to the mixing platform by an endless chain with projections engaging the axle of the car, which was run by an oil engine. This engine was belted to the drive shaft of the chain so as to reduce the speed of the latter to about 60 ft. per minute. The incline was about 40 ft. long.

"H E'S a darn good man," says the Big Boss, "an' I think we want him."

"An'," says his general super, "howdjer know that? Ye've never even seen him."

"I don't have to," replied the Old Man. "I know enough about what he can do fr'm readin' all the write-ups on his work in

HINTS FOR THE CONTRACTOR

On reaching the mixing platform the contents of the car were dumped into the mixer hopper, where the cement was added. The cement was unloaded from the cars by hand, and delivered to the charging platform on gravity rollers. Sufficient space was provided on the platform to store cement for one day's run, which required, on the average, about 1500 sacks.

The total quantity of concrete to be placed by this plant is 12,000 yd. Its cost so far,

for mixing only, not including unloading or hoisting and placing, is estimated at about 17 cents a yard. The work on which this plant was used was in charge of A. E. Hodges, superintendent for the contractor, under whom the writer was assistant superintendent.



OVAL TRACK WITH CAR ELEVATOR MADE IT POSSIBLE TO SHORTEN SPOUTING BY PLACING TOWER AT CENTER OF LARGE BUILDING

Mount Old Stove and Barrel on Sled to Make Portable Water Heater

By EARL D. COVELL

Constructing Engineer, Missoula, Mont.

A PORTABLE water heater used very successfully by the writer in building small concrete structures for irrigation canals of the U. S. Reclamation Service is shown in the sketch. As the structures averaged between 6 and 10 cu. yd. of concrete each, it was necessary



HEATER USED FOR SCATTERED JOBS AVERAGING LESS THAN 10 YARDS OF CONCRETE EACH

to have some means of heating the water that could be moved easily and quickly.

The heater built consists of a common sheet-iron heating stove inside which was fitted a coil of 1-in. black iron pipe with three turns, the ends of which were fastened into the sides of the water barrel with lock nuts. The stove and barrel were wired securely to a stone boat. When the concrete mixer was moved from place to place the heater was pulled along behind with ease.

A similar arrangement was also used for heating water in making concrete pipe in an enclosure during winter months. The cost of securing hot water with this rig was reduced to a minimum by using scrap pieces of form lumber.

The Elusive Cement Sack Again

By F. C. YEATON

Oak Park, Ill.

WHILE the clever ditty blaming the Polak, Dago, Hunkie and Ginny for the disappearance of cement sacks, published on page 400 of the Engineering Record of March 10 last, is undoubtedly justified by fact, still it should not be forgotten that many hundreds, or even thousands, of sacks are lost through the carelessness of the contractor himself.

For instance, on a certain construction job a storehouse nearly full of sacks was destroyed by fire without the possible salvage of a single sack. One month

later, a tent erected in its stead, and containing a thousand sacks, was washed away by high water over night.

Contractors habitually erect their storage houses for sacks with little thought for their safety from such accidents, in spite of the fact that one fire or flood may destroy enough sacks to cost the contractor a large part of his entire profit on the job.

Jointed Pipe, Cheaper Than Steam Hose, Saved Delay in Getting Latter

By H. W. STREULI

New York City

ON A SMALL JOB requiring the driving of only 15 piles, the operation of the fairly heavy steam hammer used would have required at least 25 ft. of 1½-in. steam hose, since it was necessary to raise and lower the hammer through nearly 20 ft. As there was no hose of this size on the job, and as it could have been obtained only after a delay of three or four days at a cost of \$30 or \$40, it became necessary to devise a substitute. Three pieces of old 1½-in. pipe were connected together with four short nipples and eight el-



OLD PIPE FITTED WITH SWING JOINTS SAVES PRICE OF STEAM HOSE AND CONSIDERABLE DELAY

bows, as shown in the illustration. This constituted a steam line with all the necessary flexibility, at little cost for materials, since the pipe and fittings were already on the job. Some of the strain was taken off the joints by means of a rope.

Where Is the Money Coming From?

The increase in revenues devoted to the construction of roads in Maryland between 1904 and 1909 amounted to 586 per cent. Delaware ran a close second, with 463 per cent increase. While Arkansas devoted only 9 per cent of her revenues to the construction of roads, the average increase for the Southern states for this period amounted to 143 per cent.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

More Engineers Appointed to Officers' Reserve Corps

Engineers' Company Steadily Growing
—Necessary to Restrict Applicants
for Major's Grade

The following recent appointments to the Engineer Officers' Reserve Corps supplement the lists that appeared in the Engineering Record of March 3, page 363, and March 17, page 445:

Majors—Rukard Hurd, Minn.; Paul Doty, Minn.; Walter L. Webb, Pa.; Jenks B. Jenkins, Md.; William J. Wilgus, N. Y.; William H. Herron, Washington, D. C.; Robert B. Marshall, Washington, D. C.; Austin C. Harper, N. Y.; Frederick J. Wood, Mass.; George E. Verrill, Conn.; F. W. La Forge, N. Y.; William B. Harrison, Washington, D. C.; A. M. Walker, Washington, D. C.; J. H. Jennings, Washington, D. C.; G. T. Hawkins, Washington, D. C.; Fred I. Wheeler, Ohio.

Captains—A. Stellhorn, Canal Zone; J. S. Herbert, Pa.; J. W. Skelly, Mo.; H. W. Hudson, N. Y.; J. D. Irving, Conn.; A. B. Searle, Washington, D. C.; E. H. Ropes, Washington, D. C.; E. B. Butchers, Pa.; F. W. Green, Mo.; W. L. Miller, Washington, D. C.; H. J. Stehli, N. Y.; J. F. Barber, Pa.; Charles B. Stanton, Pa.; Robert B. H. Begg, Va.; Charles T. Osborne, Mo.; Harrison V. Pittman, Mo.; Clyde C. Elmes, Pa.; Maxwell W. Smith, Ill.; Percy James Wilson, Mass.; Fred E. Foster, Mo.; George T. Street, Ohio.

First Lieutenants—Henry Taylor, Pa.; L. C. Josephs, Jr., N. Y.; E. L. Bandy, Washington, D. C.; Robert Boettger, N. Y.; Warren Gardner, N. Y.; T. C. Thogerson, Mo.; H. L. Haverstick, Pa.; L. S. Leopold, Pa.; S. Steenerson, Minn.; John Ross Eakin, Washington, D. C.; Luria Lyons Lee, Washington, D. C.; R. B. Carver, N. Y.; E. L. Hain, Washington, D. C.; Harry V. Newcomb, Mo.; Frank W. Hamilton, Conn.; John E. Terhune, N. Y.; Evan William Scott, Va.; James F. Ryder, Mass.; A. S. Mirick, N. Y.; E. D. Hendricks, N. Y.; T. H. Moncure, Washington, D. C.; Seth William Webb, Ohio; Samuel H. Brooks, Mass.; Frank T. Leilich, Pa.; Gordon H. Fernald, Mass.; B. D. Barker, Ill.; F. Miller, Mass.; Theodore Belzner, N. Y.; A. E. Crane, N. J.; F. N. Wildish, Ill.; R. William Queal, Mo.; John G. Kelly, Jr., Ore.; Robert W. McLean, Mass.; Louis N. Sperry, N. Y.; A. D. Stoddard, Mo.; J. R. Armington, Pa.; Alexander A. Laird, Tex.

Second Lieutenants—L. D. Coles,

American Railway Engineering Association Adds Much Material to Its Manual

Cut and Screw Spikes, Ashpits, Freighthouse Scale Location, Wall Formulas, Concrete-Pile Design, Surface Finish, Embankment Shrinkage Are Subjects Discussed

Despite the absence in Washington, because of the conflicting valuation hearing, of a number of familiar faces, the American Railway Engineering Association's convention in Chicago, March 20, 21 and 22, was able to enroll nearly its usual number of railroad officials. At the Appliance Show the attendance (22,352) even exceeded that of former years.

The Committee on Grading of Lumber was honored with a crowded roomful, and a spirited discussion arose over the proposal to limit treatment to dense Southern pine only. While the convention conceded that concrete for trestles was better than timber in most ways, it would not agree to the definite figure proposed by the Committee on Wooden Bridges and Trestles.

A. S. Baldwin's presidential address called attention to the added usefulness of the *Manual*, a canvass of roads indicating that the standards and specifications are gradually bringing about a general unification of practice. The extent of military preparedness, the prediction that the Interstate Commerce Commission valuation would be completed by Jan. 1, 1920, and co-operation with other engineering societies in Chicago for the purpose of getting a home for all, as proposed recently by the Chicago Engineers' Club, were subjects discussed by Mr. Baldwin.

To Subscribers for the Engineering Record and Engineering News

Subscriptions for the Engineering Record and Engineering News will be continued automatically as subscriptions to the Engineering News-Record, effective with this issue. Where both papers have been subscribed for, the unexpired terms of the two subscriptions will be added together and applied on the Engineering News-Record. In other words, readers will get for the unexpired terms of their subscriptions the greatly increased value that will result from the consolidation of the two papers.

Wooden Bridges and Trestles.—

Strenuous objection was made to the definite statement that creosoted timber trestles are more economical than concrete when the cost of the concrete structure is less than one and one-half times the cost of the wooden structure. Formulas were given showing the comparative economic value of the two types. Two tables, assuming a life of twenty or twenty-five years for the timber and from thirty to one hundred years for the concrete, were made up showing comparable costs per linear foot for each. The committee contended for these that they were examples only and the engineer could use his own estimates.

Discussion of Reports

J. G. Sullivan (Canadian Pacific) objected to the use of a sinking fund at 6 per cent on the ground that banks will not pay so much. A. F. Robinson (Santa Fé) felt that there should be a restriction as to the height of timber trestles. If more than 20 ft. the fire danger is greater and much time is necessary to rebuild.

E. A. Frink (Seaboard Air Line) of the committee explained that the 1:1½ ratio was only a rough approximation and applied to trestles under 23 ft. high.

Hunter McDonald (Nashville, Chattanooga & St. Louis) called attention to conditions where drainage may permit trestled crossings to be filled and a long-lived concrete trestle could not be recovered. In other places floods make necessary the lifting of the whole roadbed every few years because of the filling in of material. Under these conditions it is a mistake to build too permanent a structure; there would be more risk of loss—non-recovery—with a concrete structure.

Conclusions Adopted

After several speakers gave information as to the cost of trestles and the small maintenance of both types, Mr. Frink stated that the conclusions were purely mathematical and not based on data collected. This one conclusion was voted down, but others relating to fire hazard, stability against the action of floods, service qualities, appearance and conservation of materials were adopted.

Stresses in Railroad Track.—Prof. A. N. Talbot reported progress only for this special committee co-operating with

a similar one of the American Society of Civil Engineers. He stated that tests indicate that stresses 18 or 20 in. below the tie become nearly uniform in a direction parallel to the track.

Track.—Specifications for cut and screw spikes, which have been before the association for some time, were adopted with a few minor changes. Earl Stimson (Baltimore & Ohio) objected to the form proposed on the ground that it was not possible to make the spike in the present automatic machines, although they could be made in hand machines. Manufacturers have assured the committee, however, that the new spike can be made automatically.

H. R. Safford (Grand Trunk), vice-chairman, asked to change the figures under "physical properties and tests" to read "elongation not less than 25 per cent in 2 in., or if test is made on bar, 20 per cent in 8 in." because the percentage of elongation is greater for short specimens than for longer ones.

Ballast.—The order in which various materials are considered best was left as the committee set them down when the word "about" was used as a qualifying term and it had been explained that this order referred to the best quality of each.

J. L. Downs (Illinois Central) stated that there was a marked difference between a pit-washed gravel and a river-washed gravel, because the former was sharp-grained and the latter round-grained.

R. H. Ford (Rock Island) contended that a sub-ballast cinder blanket of cinders of less than 12 in., even down to 4 in., had been found effective in preventing mud from working upward, but the convention approved the committee's 12-in. recommendation. Mr. Ford's arguments against the adoption of a standard class A ballast section to the effect that only good practice can be laid down were concurred in and all four sections submitted were referred back to the committee.

Roadway.—The expected discussion on the allowances for anticipated shrinkage in embankments did not materialize and many important recommendations of the committee were adopted without comment. These include recommendations intended as guides in the selection of equipment, material-handling, blank forms for reporting operations of equipment, shrinkage percentages and conclusions as to depressing or elevating streets where a few crossings are to be eliminated.

Yards and Terminals.—This committee's recommendations also went through with little discussion. They included the three hump profiles for gravity yards in cold, moderate and warm climates respectively.

Buildings.—The committee presented definite conclusions on freight-house scales, which were adopted although C. E. Lindsay (New York Central) felt that more than from 6 to 8 ft. should be left between the side of the house and the scales to prevent congestion.

After striking out a sentence referring to the 5-ft. depth of water in ash-

pits, the committee's recommendations on ashpits were concurred in. There was some discussion on the question of safety protection to prevent men from falling into the pits. As four men have been drowned on the Baltimore & Ohio, M. A. Long of that road, chairman of the committee, held to the recommendation for rails on the sides and inclines at the ends.

Grading of Lumber.—While the proposed specifications for Southern yellow-pine bridge and trestle timber to be treated were referred back to the committee, the discussion on the question of quality was one of the most spirited of the convention. Mr. Frink led the discussion and was armed with a large sheaf of correspondence expressing a wide diversity of opinion from officers of railroads, lumber companies and creosoting plants as to the admission or not of loblolly and shortleaf pine. He argued that if loblolly was weaker, more of it, if treated, could be used, and that the reliance of the committee on a treated envelope around the heartwood of dense pine was not, in the opinion of many, entirely effective. He would accept all three pines.

Dr. Hermann von Schrenk, chairman of the committee, explained that the restriction to dense Southern pine was to have the highest type of standard first, inasmuch as the treatment refers only to bridge and trestle timbers, stringers and sills. It has nothing to do with the treating of piles for teredo protection. Mr. Frink replied that the reason the present specification calls only for dense pine is that loblolly is not so durable.

The Committee on Grading of Lumber asked that the Committee on Wooden Bridges and Trestles give it a clear understanding as to what timbers it would consider in a first-class bridge.

Masonry.—With a change in name from precast to premolded, specifications for concrete piles of this type were accepted.

Prof. H. S. Jacoby brought up the question of artificial seasoning when the clause calling for twenty-eight days before using was under consideration. The phrase "under normal conditions" was finally added and the time allowance left to the engineer when artificial means are used.

Specifications for driving premolded piles were acceptable with minor changes, but were referred back to the committee to bring in another year with the drawings to which they referred.

L. N. Edwards, engineer of bridges, Toronto, objected to washing surfaces with water after the desired finish is obtained, holding that too much cement would be washed off and that it left the surface more open to future disintegration. F. L. Thompson (Illinois Central), chairman of the committee, explained that unless the surplus is washed off it will flake. The surface finish specifications were then passed.

The joint committee specifications for Portland cement were adopted, as were those for natural cement, which are

simply rearranged from the present requirements in the *Manual*.

R. L. Humphrey, consulting engineer, explained that the requirement for specific gravity was left out of Bulletin 194 unintentionally.

Rules and Organization.—There was considerable doubt last year as to what was adopted as a minimum clearance diagram. The committee's work of reconciling the conflicting dimensions with the previously adopted third-rail clearances for electrified roads was approved.

Officers

The officers elected for the ensuing year are as follows: President, John G. Sullivan, chief engineer, Canadian Pacific; vice-presidents, C. A. Morse, chief engineer, Chicago, Rock Island & Pacific, and Earl Stimson, engineer maintenance of way, Baltimore & Ohio; treasurer, George H. Bremner, district engineer, Division of Valuation, Interstate Commerce Commission; secretary, E. H. Fritch; directors, J. A. Atwood, W. H. Courtenay and L. A. Downs; members of nominating committee, J. R. W. Ambrose, George H. Burgess, W. M. Dawley, V. K. Hendricks and S. T. Wagner.

To Investigate Leaks in Tumalo Irrigation Project Reservoir

An investigation of the leaks in the reservoir of the Tumalo irrigation project will be undertaken within the next few weeks, according to Secretary McAllister of the State Desert Land Board, Salem, Ore. A bill appropriating \$10,000 for the investigation was passed by the legislature and provides that the board shall appoint two expert engineers, who, together with the manager of the project, shall make the investigation and make a report to the board. If they conclude that the leaks cannot be repaired, the reservoir will be abandoned, but if they can formulate a feasible plan for the repair of the leaks and its cost is within the legislative appropriation it will be adopted. Leaks were discovered in the big reservoir in 1915, and it has since been out of commission, although attempts were made to repair it.

Smoke-Abatement Ordinance in Cleveland Revised

The newly revised and supplemented smoke-abatement ordinance of Cleveland, approved by the acting Mayor March 2, contains provisions for a commissioner of smoke inspection in the Department of Public Safety. He must approve plans for the construction of new installations and of the reconstruction of old plants, but his approval does not exempt owners in case the plant should emit dense smoke for a period longer than six minutes in any one hour. Fines range from \$10 to \$100. Noxious fumes or gases from metallurgical furnaces, stills and galvanizing plants are declared to be a nuisance.

More Engineers Appointed to Officers' Reserve Corps Navy Department Announces Important Examination

(CONTINUED FROM PAGE 521)

N. J.; M. E. Pumphrey, Ill.; Herman Larsen, Wis.; William F. Barck, N. Y.; Albert Holmes, Washington, D. C.; Oliver G. Taylor, Washington, D. C.; Frank A. Danforth, Washington, D. C.; Charles A. Case, Kan.; Frank C. Dugan, Ohio; W. E. Stark, Ohio; R. W. P. LeBaron, Ill.; Alexander Kennedy, Jr., N. Y.; James M. Rawls, Washington, D. C.; A. H. Davison, N. Y.; G. B. McClary, Ill.

Due to the fact that about 900 applications have been received for the grade of major, it was necessary to reject about one-third of them or to commission the applicants in a lower grade. It has been finally decided to adopt the rule that no major would be commissioned under forty-five years of age. It was thought by the department that this rule would give the best results and cause the least dissatisfaction.

St. Paul Starts Work on Station

St. Paul, Minn., recently celebrated the beginning of work on the new \$11,000,000 union station to be erected by the St. Paul Union Depot Company.

Special attention is directed to the following civil service examinations to fill vacancies in the U. S. Navy Department, Bureau of Yards and Docks:

Assistant Civil Engineer.—Not less than six nor more than nine vacancies to be filled. Appointees are commissioned with the rank of lieutenant (junior grade) with pay and allowances approximating \$2500 a year. The highest rank in the Corps of Civil Engineers is rear admiral, carrying with it, including pay and allowances, a remuneration of approximately \$9500 a year.

The examination will be in two parts: (1) A preliminary, to determine the candidate's general fitness, based on his collegiate record, testimonials, statements of references and professional experience. Candidates will not be assembled for this examination, but will submit their papers by mail direct to the examining board in Washington; (2) a final, including an oral and written examination, to be held in Washington, D. C., and open only to those who have passed the preliminary examination. Candidates before the final examination will be examined as to physical fitness by a board of medical

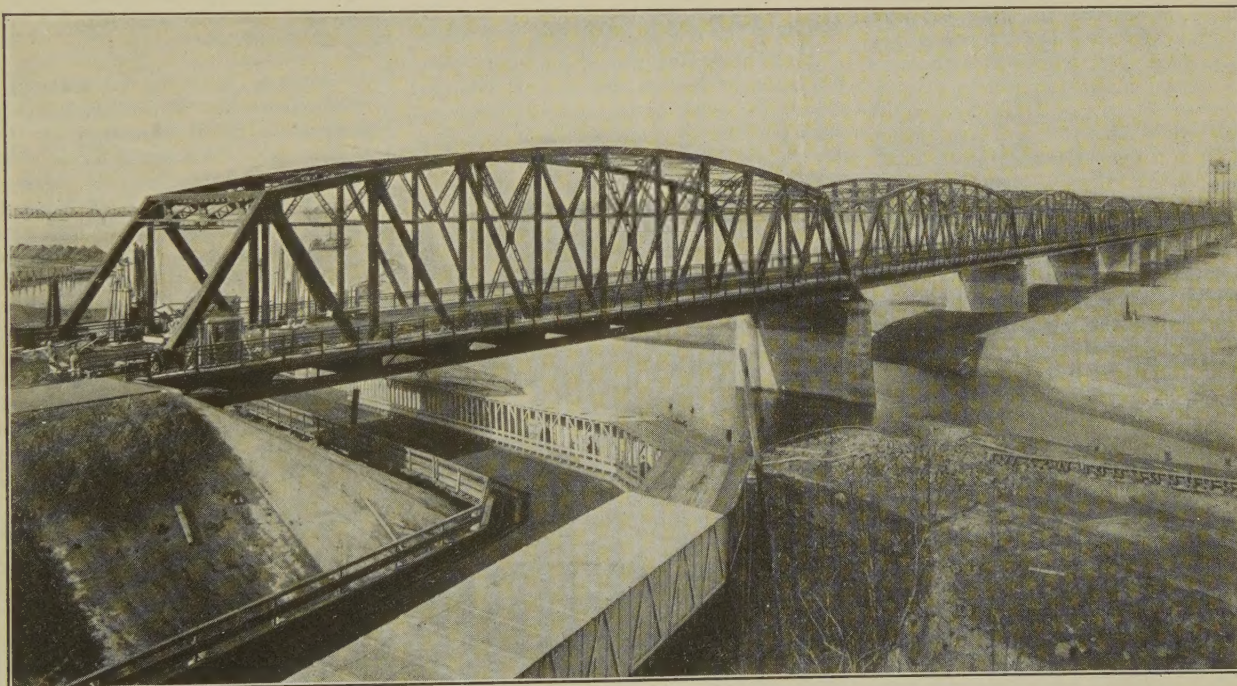
officers of the U. S. Navy. If found to be physically unfit the candidate will not be further examined. The following are pre-requisites for consideration: No candidate over 26 years of age on Jan. 1, 1917, will be eligible for examination; the candidate must be an American citizen; must have received a degree from a college or university of recognized standing, showing that he has satisfactorily completed a course in engineering; must have had not less than 18 months' practical professional experience since graduation, and must be of good moral character and repute.

For further information address the Chief of Bureau of Yards and Docks, Navy Department, Washington, D. C.

Idaho to Spend \$2,720,000 on Road Construction

The Idaho Legislature recently passed a bill providing for a \$1,000,000-bond issue for good roads in the state. This act will make available for road construction during the next two years a grand total of \$2,720,000, of which \$1,000,000 will be raised by the state, \$1,250,000 by the counties, \$335,000 from the Federal Aid road act and \$135,000 from the Forest Service. E. M. Booth is state highway engineer.

New Highway Bridge First to Span Lower Columbia River



THE Interstate Bridge, connecting Portland, Ore., and Vancouver, Wash., recently opened, is the first bridge to carry traffic across the lower Columbia River. Its opening removes the last obstacle to the Pacific Highway, which has been blocked only at this one point from Mexico to Canada.

In addition to highway traffic, however, the bridge will carry six lines of rails to provide double tracks for both broad and narrow gage electric cars. Work on the bridge was started in March, 1915, and it was opened to traffic February, 1917. A complete description of the bridge appeared in the Engineering Record of July 8, 1916,

page 36. Harrington, Howard & Ash, of Kansas City, Mo., were the consulting engineers in charge of the design and construction. Contractors on the structure were the Pacific Bridge Company, U. S. Steel Products Company, Porter Brothers, Tacoma Dredging Company and Standard American Dredging Company.

U. S. to Investigate Fields in Russia and Far East

Russian and Far Eastern fields for American investments are to be investigated at once by the Bureau of Foreign and Domestic Commerce of the U. S. Department of Commerce. A. W. Ferrin, president of the Moody Magazine & Book Company and editor of Moody's Magazine, has been appointed trade commissioner to make the investigation and will sail from San Francisco on April 30. In the meantime, he will visit some of the principal business centers in this country and consult with persons especially interested in the investigation.

Mr. Ferrin will include in his trip Japan, Russia, China, the Philippines, the Dutch, British and French East Indies, the Straits Settlement, Australia, New Zealand, Ceylon, India and East and South Africa. He will study investment opportunities in these countries and will report on financial conditions, banking, railroad and public utility, and other forms of finance, with particular reference to the extension of American foreign trade.

San Francisco Engineers Study Tactics

Since the Engineers' Corps of California has been discontinued, a group of young engineers in San Francisco has arranged to co-operate in studying subjects that would be particularly useful to engineers in time of war. The course of study has been outlined with the idea that what the engineers need is not training in military engineering so much as training in the tactical operations of warfare which would have a bearing on military engineering. The civilian engineer is equipped to carry out the engineering work proper, but would be at a disadvantage in providing adequate military protection during construction, and would not be familiar with the principles governing the purpose for which certain survey and construction work would be required.

Study Principles of Organization

As laid out, the course involves weekly meetings in preparation for which the students study the theory and principles of organization, the inter-relation existing from private to commander in field forces, the inter-relation between the different arms, preparation of records looking to the maintenance of communication and supply, and the analysis of field equipment. Map and patrolling problems are taken up, and, finally, a progressive problem involving practically all the instruction that precedes it is worked out.

This progressive problem, which is worked out by the class on a large scale wall map, is handled so as to bring out the definite strategy behind a movement involving engineer troops, outlines the grand tactics that lead to the

initiation of the movement, and develops in full the minor tactics with due regard to field service regulations of the various arms involved. This includes theoretical engagements, in which members of the class officer the forces on one side, and a referee announces decisions as to the success of the strategical moves and the operations of the enemy.

The course is planned to give the engineer a thorough grounding in subjects required in the examinations for the officers' reserve corps. At the same time it is laid out so as to make it of continuous interest, and of certain service to the engineer in time of war whether he takes the examinations or not. The work has been organized and directed by J. W. Swaren, of Hayward, Cal.

Move for Engineers' Building in Chicago

A home for all of the engineering societies in Chicago is the proposition which the Chicago Engineers' Club has under serious consideration. An inquiry sent to eleven societies brought favorable response from nine of the organizations, the inference being that, provided a definite and practical scheme were evolved by the Chicago Engineers' Club, the opportunity for negotiating for space would be welcomed. There is the possibility of augmenting the present quarters by purchasing adjacent property or by going to an entirely new site.

Hogs Will Eat Topeka Garbage

A scientific hog ranch, on which none but animals immunized against cholera are to be kept, is to be established to care for the garbage of Topeka, Kan. W. L. Porter, commissioner of parks and public property, writes that a contract to collect all the garbage free to the citizens and free to the city has been entered into. Collections will be made once a day all over the city from May 1 to Oct. 1, and for the colder six months once a day in the business districts and twice a week in the residential portion of the city.

Offer Prizes for Road Arguments

Prizes will be given in the State of Oregon for the best arguments favoring the adoption of the \$6,000,000 road bond issue to be voted upon in June. Each of the 36 counties in Oregon will have its own contest, which will be so arranged that one competition will be for the State at large, another will be confined to each particular county, another will be open to grammar school students, and another to high school students. Money for the prizes will be raised by popular subscription, and collected by the committee. Winning arguments will be offered to the press of the State for publication, and parts of the best essays will probably be included in the voter's pamphlet which will be issued by the State.

What Engineers and Contractors Are Doing

C. A. PECK, who was formerly in the employ of the Rivers, Harbors and Bridges Commission of Connecticut on the construction of the \$1,000,000 steamship terminal at New London, Conn., is now with C. A. Tinker of Stafford Springs, Conn., as construction engineer engaged in mill building and power-plant installation. Mr. Peck was employed by the American Telephone & Telegraph Company as inspector on the underground installation from Washington to Boston. Since 1912 he has been in the employ of the state of Connecticut and for a year and a half on the erection of a highway drawbridge over the Connecticut River at East Haddam.

P. D. VAN VLIET has been appointed publicity manager for the Universal Portland Cement Company, with whom he has been employed seven years. After graduation from Cornell University as a civil engineer, Mr. Van Vliet was with the Arnold Company, Chicago, in hydroelectric and irrigation design until 1910.

F. CLARKE DUGAN has resigned from the Division of Sewerage, Cincinnati, to become assistant engineer with William G. Clark, consulting engineer, Toledo, Ohio. Mr. Dugan was graduated from the University of Kentucky in 1910 and was connected with the Sewerage Commission of Louisville, Ky., until 1913.

ALGER & KRAUS, contracting engineers, Guardian Building, Cleveland, has recently been organized by Ralph J. Alger and Arthur A. Kraus. Both Mr. Alger and Mr. Kraus were resident engineers for the New York Continental Jewell Filtration Company. Mr. Kraus has just been in charge of the erection of the Kenosha (Wis.) filter plant, which is practically completed, while Mr. Alger recently completed a plant for the Goodyear Tire & Rubber Company at Akron, Ohio. Previously both members of the firm were engaged on other purification plants. Mr. Kraus is a graduate of New York University, while Mr. Alger was graduated from both Harvard and Massachusetts Institute of Technology.

L. D. LEA, formerly city engineer of Lead, S. D., has resigned to go with the Export Service Corporation, First National Bank Building, Chicago, as chief engineer. He is at present planning construction work to be undertaken in Colombia, S. A.

S. BENSON, of Portland, Ore., has been elected chairman of the Oregon State Highway Commission.

SAMUEL D. WILLIAMS, division engineer of the Michigan Central Railroad, with headquarters at St. Thomas, Ont., has been transferred to the company's main office at Detroit.

H. MCL. HARDING, consulting terminal engineer of New York City, has been appointed consulting terminal expert in connection with the building of a chain of terminals to be located at various cities along the New York State barge canal. Mr. Harding is president of the Society of Terminal Engineers, recently organized in New York City.

S. C. PRICE has been appointed city engineer of Goldendale, Wash.

C. S. BILYEAU, formerly connected with Hildreth & Company, engineers, of New York City, recently became associated with Gulick-Henderson and will be located in their general office in New York City.

HARRISON W. CRAVER, chief librarian of the Carnegie Library of Pittsburgh since 1908, has resigned to become director of the library of the United Engineering Societies of New York City. His new position will put him in direction of what is believed to be the largest engineering library in the world, with approximately 150,000 volumes on technological subjects.

G. E. STELLER has resigned from the inventory department of the Southern California Edison Company to become chief draftsman for the Southern Counties Gas Company of California.

C. C. COOK, division engineer of the Pittsburgh division of the Baltimore & Ohio Railroad, at Pittsburgh, has been appointed district engineer of maintenance of way of the West Virginia district, at Wheeling, W. Va. Mr. Cook entered the service of the Baltimore & Ohio Railroad as an axeman and was subsequently engineer, chief draftsman and division engineer. He was promoted to division engineer at Philadelphia in 1911 and was transferred to Pittsburgh in 1913.

BENJAMIN F. WOOD, for sixteen years electrical engineer with the Pennsylvania Railroad and for the last three years vice-president and chief engineer of the United Gas & Electric Engineering Corporation, has organized B. F. Wood Engineers, Inc., Woolworth Building, New York City, to investigate, design, construct and supervise engineering works in power development, transmission, railroad electrification, electric railways, lighting systems and industrial plants.

F. S. SMALL has resigned as acting district engineer in the Canadian Department of Public Works, in charge of the St. John River district. Mr. Small joined the department in June, 1914, as assistant engineer and became acting district engineer Jan. 1, 1916.

R. L. SLOCUM has been made assistant superintendent of the Universal Portland Cement Company's mill at Universal, Pa. Mr. Slocum was graduated from Pennsylvania State College in 1905. He spent two years in construction for the Homestead Steel Works and began work in the spring of 1907 for the Universal Portland Cement Company in charge of building

construction and the installation of machinery at Universal. He is now in charge of plant operation and management under the superintendent.

JEROME NEWMAN, formerly chief engineer of the California State Board of Harbor Commissioners, has opened an office as consulting engineer at 260 California Street, San Francisco. Special attention will be given, it is announced, to valuation and cost of service in connection with public utilities.

ROBERT ISHAM RANDOLPH, consulting engineer, on March 29 addressed the membership conference of the Chicago Association of Commerce on "The Business Man and the Function of the Consulting Engineer."

F. D. STANLEY and J. W. BAILEY have formed a partnership with offices in the Citizens' National Bank Building, Baker, Ore., to conduct a general engineering business. Mr. Stanley has been engaged in mining engineering and Mr. Bailey was formerly city engineer of Baker, Ore.

H. R. GERRARD, Alberni, B. C., has been appointed city engineer of Duncan, Vancouver Island.

MELVIN O. SYLIASSEN, structural engineer, and G. R. Hawes, formerly chief draftsman, Chicago, Milwaukee & St. Paul Railway, both of Seattle, Wash., have accepted positions under V. D. Simons, industrial engineer, Vancouver, B. C., and will engage in the construction of pulp and paper mills throughout the province.

C. C. JONES, formerly in the engineering department of the Chicago, Milwaukee & St. Paul Railway, Chicago, has entered the firm of Jones & Bohmke, engineers and contractors, Hutchinson, Kan.

ERWIN O. HATHAWAY, recently appointed district engineer for the fourth district of the U. S. Office of Public Roads, has established headquarters in the New Post Office Building at Minneapolis, Minn. Mr. Hathaway has been for nearly four years senior highway engineer in the Office of Public Roads, previous to which time he was for eight years division engineer in the New Hampshire Highway Department and for about four years city engineer of Nashua, N. H.

S. A. JUDSON has resigned from the topographic branch of the U. S. Geological Survey to engage in topographic engineering and oil geology for F. Julius Fohs, consulting oil geologist, Gallais Building, Tulsa, Okla.

M. H. DOUGHTY has been appointed assistant to the chief engineer of Delaware, Lackawanna & Western Railroad, Hoboken, N. J., having charge of the general drafting office and of valuation.

H. S. OWEN has accepted the position of field engineer for the Kansas City office of the Portland Cement Association, with headquarters in St.

Louis, Mo. Mr. Owen was formerly principal assistant to the chief engineer of construction, Department of Streets and Sewers of St. Louis, Mo.

P. W. CLANCY has been appointed the Nebraska representative of the Kansas City office of the Portland Cement Association. Mr. Clancy was formerly engaged in municipal work and was resident engineer on construction for the Canadian Northern Railway and Union Pacific Railway.

C. I. FELPS has been appointed field engineer for the Kansas City office of the Portland Cement Association, with headquarters in Wichita, Kan. Mr. Felps was formerly with the Kansas State Highway Department and was recently with the bridge department of the Kansas City Terminal Railway Company.

M. E. REEDY, formerly assistant engineer with the U. S. Reclamation Service in charge of the location and construction of the East Park feed canal of the Orland project, has been made assistant engineer in the hydraulic department of the California State Railroad Commission. For a short period after leaving the reclamation service Mr. Reedy was in the design department of the Chicago, Milwaukee & St. Paul Railway at Chicago.

A. N. JOHNSON, consulting highway engineer of the Portland Cement Association, has been appointed on the committee of the American Association of State Highway Officials which is collecting information as to changes which the States expect to make in their highway laws. Many States are at present planning revision or amendment of such laws so that they may take advantage of government aid in road improvements.

Obituary Notes

JOHN KASSON HOWE, dredge engineer of the Osgood Dredge Company, Albany, N. Y., and the Osgood Company, Marion, Ohio, died March 4. Mr. Howe organized the Osgood Dredge Company in 1883. This company obtained the original patents on the boom-type dredge. He was secretary and treasurer of the Osgood Dredge Company until its consolidation with the Osgood Company, when he became a director in the latter company and its Eastern sales representative.

J. E. GARDNER, city engineer of Napa, Cal., and formerly construction engineer for many years with the Southern Pacific Company, died March 13.

ELISHA K. GREEN, who was prominent in the early development of a water system for Los Angeles, died recently in that city at the age of 78.

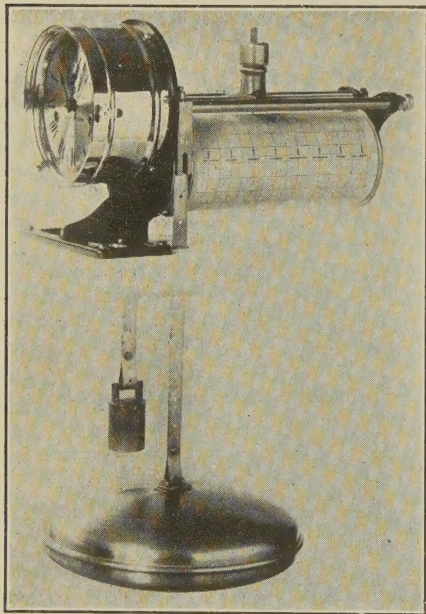
Develop Walking Dredge for Light-Weight Road Pump Is Ditch Work Mounted

For contractors engaged in drainage and ditching work the Bay City Dredge Works, of Bay City, Mich., has developed a new type of land dredge. This is a walking dredge using a series of feet in place of the steel trucks and sectional track for moving the dredge ahead on the work.

The builders state that this walking dredge will work successfully over rough, marshy or slippery ground, that no track, skids or extra planking is required and that the dredge will be found particularly desirable in drainage districts where the yardage per station is small. The dredge was given a tryout in Minnesota during 1916.

Stage Register Developed for Irrigation

A seven-day accurate, compact register has been developed by W. & L. E. Gurley, Troy, N. Y., for use in connection with irrigation and sewage-disposal weirs. It is stated that its construction is such that no lost motion will develop from continuous service and that it can be operated with min-

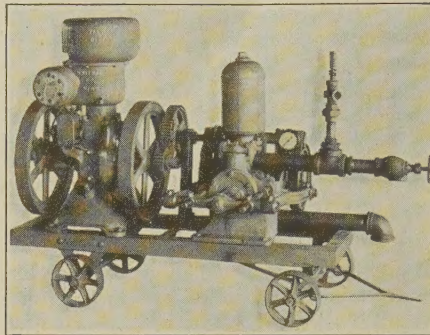


WATER STAGE REGISTER MAKES SEVEN-DAY GRAPH IN 1-FOOT RANGE

imum care and expense. It gives a record to 0.01 ft. on a ruled sheet, the rulings covering a space of 12 x 7½ in. The vertical rulings indicate the water stage for range of either 1 or 2 ft., as desired. The time scale is 1 in. horizontally for each 24 hours.

If desired, the feed screws on the register can be changed so that the pencil will travel 8 in. in 24 hours, on sheets ruled 12 lines to the inch. Each space thus represents 15 minutes. This will necessitate changing the sheet every day. This register, which is furnished with a float 10 in. in diameter, is sold for \$65 or \$75, depending on whether the range is for 1 or 2 ft.

A new light, high-pressure pump delivering 33 gal. per minute under a head of 270 ft. has been put on the market for use in construction road work. For this purpose it is mounted as shown in the photograph. At capac-



MOUNTED PUMP OUTFIT FOR ROAD WORK GIVES HIGH PRESSURE

ities of from 32 to 110 gal. per minute it is claimed it will deliver water a distance of 3 miles. The valves are of the spinning type, self-cleaning and self-grinding. It is a single cylinder, double-acting pump built in six sizes varying from 3 x 5 in. to 6 x 6 in. The weight of the 5 x 5-in. size, with 3-hp. engine, is 1100 lb. The outfit is built by the Whitman Agricultural Company, St. Louis.

Trade Notes

Permutit Company, 30 East Forty-second Street, New York City, announces that Cass L. Kennicott, expert in water softening and filtration, has become associated with the company in charge of the Chicago office, 208 South La Salle Street, Chicago.

Metropolitan Paving Brick Company, of Canton, Ohio, announces the purchase of the brick interests of the Bessemer Limestone Company, of Youngstown, Ohio. By the terms of the purchase the Metropolitan company has acquired the brick kilns of the Bessemer company, which are located at Bessemer, Pa., including several hundred acres of paving-brick shale. The general office of the company will be at Canton, Ohio, as in the past.

Pulsometer Steam Pump Company, Chicago office, has been changed from the Lytton Building to 415 South Dearborn Street, Old Colony Building.

Chain Belt Company has retained John M. Trevor, 30 Church Street, New York City, to sell its Rex concrete mixer.

Berger Manufacturing Company has recently made the following appointments: Division of building material, R. W. VanHorn; efficiency engineer, Norman A. Hill; sidewalk-light department, P. V. Stonerod, and chief engineer of sales department, A. H. Bromley, Jr.

Irwin Newman, engineer, of Chicago, Ill., has opened an office at 945 First National Bank Building, where he is representing the Reeves-Cubberly Engine Company, of Trenton, N. J., and the D'Olier Centrifugal Pump & Machine Company, of Philadelphia, Pa.

Norcross Brothers Company, now starting on its fifty-second year of continuous service has reorganized. O. W. Norcross is chairman and E. F. Jones is president of board of directors. The offices are in Worcester and Boston, Mass.; New York City, Providence, R. I., and Montreal, Que.

Alaska Railroad Commission has opened offices in San Francisco. G. H. Gamble, formerly with the Northwestern Pacific Railroad in San Francisco, is in charge as resident purchasing agent.

Turner Construction Company announces the removal of its New York offices from 11 Broadway to 244 Madison Avenue.

The Clinton Wire Cloth Company, Boston, Mass., is being reorganized. Mr. Charles F. Fairbanks, who has been treasurer of the company, will remain in the same capacity in the new organization, representing the financial interests which have taken over the property. Clinton products have been on the market since 1856 and the structural materials now made include wire lath of various types and electrically-welded fabric for reinforcing concrete. As part of the reorganization, a new department to be known as the Structural Products Department, and in charge of Royall D. Bradbury, will be formed. Its object will be to extend and broaden the field for the company's structural materials and to develop and perfect new products. In the reorganization, moreover, the selling arrangements of the company will be completely changed. Albert Oliver & Son, Inc., will take over the selling for the entire territory east of the Rocky Mountains and have engaged the entire floor of the Flatiron Building, New York, for their offices. The territory is to be covered as rapidly and efficiently as possible, pushing particularly electrically welded fabric for the reinforcement of concrete roads.

The Hercules Cement Corporation, of Philadelphia, Pa. (mill at Stockertown, Pa.), has taken offices at 30 East Forty-second Street, New York City, which will serve as headquarters for its sales department. E. B. Goode, Jr., who for the last four years has been metropolitan district sales manager for the Lehigh Portland Cement Company, has been appointed sales manager of the corporation, and will take up the duties of that office at once. He will commence his organization work immediately and will be established in his new headquarters by April 1. Mr. Goode has been active in the building material line for eleven years, having been with the Wotherspoon Plaster Mills, Inc., before entering the services of the Lehigh Portland Cement Company.